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ENVIRONMENTAL ASSESSMENT FOR THE REMOVAL OF CONTAMINATED SOIL AT THE ROCKY FLATS PLANT OF THE U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

December 15, 1975

ABSTRACT

The plan for the removal of plutonium contaminated soil from an area of about 2,000 square metres to an average depth of 15 centimetres is described.

This action will provide an opportunity for coordinated study of soil removal techniques and their effectiveness in preventing resuspension of plutonium contaminated particles. Backfilling with topsoil and seeding should establish adequate grass cover in approximately two years.

No significant adverse impact on the environment is expected and the U.S. Energy Research and Development Administration recommends that no environmental impact statement be made.

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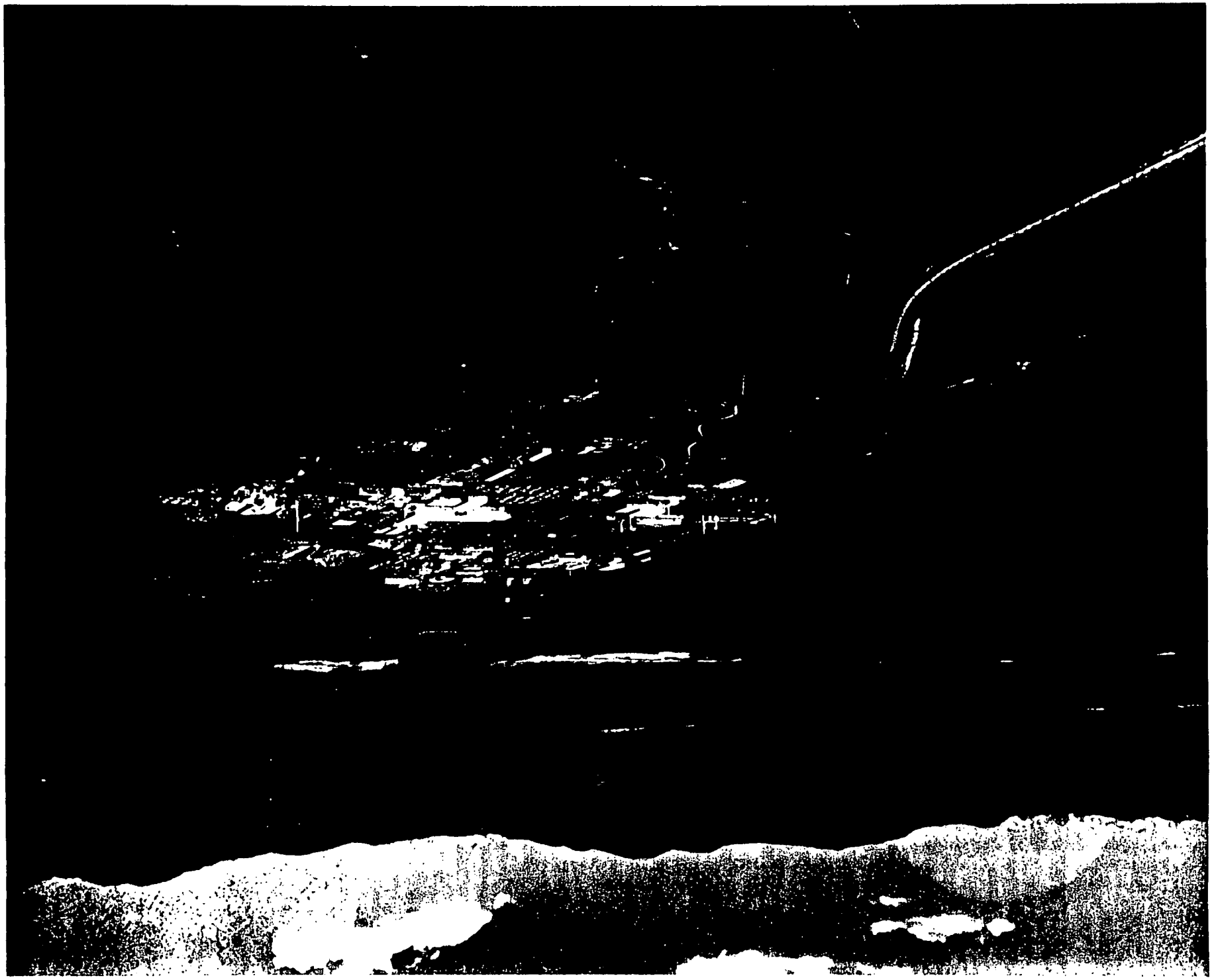
I. GENERAL STATEMENT

This environmental assessment has been prepared in compliance with the National Environmental Policy Act of 1969. The purpose of this assessment is to describe the planned U.S. Energy Research and Development Administration (ERDA) action of removing contaminated soil at the Rockwell International, Atomics International Division (AI), Rocky Flats Plant and to assess the potential impacts of this action on the surrounding environment. The areas of soil to be removed are located within the security fence that surrounds the Rocky Flats Plant (Figure 1). A closer view, indicating the areas of excavation, is shown in Figure 2.

Careful assessment of this planned action indicates that little, if any, adverse environmental impact would result if the plan were implemented. In fact, there would be an environmental benefit since soil containing measurable concentrations of plutonium would be removed, and potential resuspension from the excavated areas would be prevented.

Since this action is not expected to have any significant adverse impact on the environment, ERDA recommends that no environmental impact statement be prepared.



II. BACKGROUND

A. Existing Situation

The Rocky Flats plant was established in 1951 on a broad plateau just east of the Rocky Mountains. Prior to construction of the plant, the land was used for grazing, which carried a significant impact on the plant and animal populations of the area. The plant is a manufacturing facility of the Energy Research and Development Agency (formerly the Atomic Energy Commission). Primary operations of the plant include the fabrication and recovery of nuclear materials including plutonium.

During the time period between 1959 and 1967, approximately 5240 drums of plutonium and uranium contaminated machining oil and lathe coolant were stored in the 903 Area, also known as the Oil Drum Storage Field. The approximate location of the drums was near the center of the presently existing asphalt pad shown in Figure 2. The first drums were placed in the 903 Area in July 1959 and the first drums were removed in January 1967. During the eight years of outdoor storage, several drums were damaged by corrosion which resulted in oil leakage. It has since been estimated

by Rocky Flats personnel that approximately 5,000 gallons of oil containing an estimated 5.4 curies* of plutonium-239 leaked from approximately 100 corroded drums into the soil.[1]

During the period between the initiation of the drum removal project and October 1969, when the asphalt pad was placed over the old drum storage area to contain the plutonium in the soil, approximately one curie of plutonium-239 was redistributed away from the pad area by construction operations and natural forces and spread over an area of more than 2,000 acres (809 ha). Krey[2] has calculated a slightly different inventory. His current estimates include 1.4 curies beyond the 3 mCi/km^2 contour and 10 curies inside the 3 mCi/km^2 contour. The latter value includes 1.4 curies off site and 8.6 curies on Rocky Flats land. The total estimated plutonium released by Rocky Flats, according to Krey, was 11.4 curies, which is about twice that estimated by Seed, et al.[1] Krey's explanation for this difference is related to his soil sampling depth of 20 centimetres. Others took either the top one or five centimetres. The major concentrations were spread to the east and south of the asphalt pad, and

*One curie of plutonium-239 represents about 16 grams of that radioisotope.

it is now estimated that approximately 0.56 curie of that plutonium is within the areas shown in Figure 2.

The contaminated soil is situated on the side of a small ancient erosional valley which has cut through the old Rocky Flats pediment surface. At the present time, limited erosion of the slope occurs only during exceptionally wet weather by sloughing of the surface layers. The area was vegetated with mixed prairie grasses. There were also abundant tall-growing mullein plants, scattered small forbs and sedge and sparce shrubs like rabbitbrush, pincushion cactus, and plains pricklypear. Vegetation covered about 70% of the ground surface until May 1975 at which time a herbicide was applied to prepare the area for excavation.* Subsequently the area was irrigated with an equivalent of 30 inches of rainfall, a sacrificial crop of millet was planted, and excelsior soil retention mats were laid down. Recovery of vegetation in the area is expected by the fall of 1976.

Surveys at the time of the drum removal project and subsequent annual soil sampling detected a maximum plutonium-239 concentration of 5,680 d/m/g (2558 pCi/g) in the top

*See Appendix I.

5 cm of soil in the general area southeast of the Oil Drum Storage Field. In June 1973, an aerial radiological monitoring survey (ARMS) by EG&G, Inc., of Las Vegas, Nevada, detected radioactive anomalies located close to the planned soil excavation sites in Figure 2.[3] This was the first indication of a contaminated area rather than isolated plutonium-in-soil anomalies. In June 1973, personnel from the ERDA Health and Safety Laboratory (HASL) conducted simultaneous soil sampling and direct reading surveys of the area using a field instrument for detecting low energy radiation (a FIDLER), which confirmed the ARMS survey.

On the basis of these preliminary surveys, it was decided to do a more extensive study, including soil profile analyses (see Figure 3 for the location of sample sites). The purpose of the study was to obtain an accurate assessment, which would allow quantification of plutonium concentrations in the soil. The first step was a ground survey with a FIDLER. The results are shown in Figure 4. Thirty-seven soil samples were collected at 50-ft (15-m) intervals along eight parallel traverses 100 ft (30 m) apart. Six additional samples were later collected along six of the traverses. Samples were taken to a depth of 5 cm in a 10- by 10-cm square. The samples were air dried, sieved through a 35-mesh screen and analyzed for plutonium by the method of Talvitie.[4] Results are reported on a dry weight basis in Figure 5.

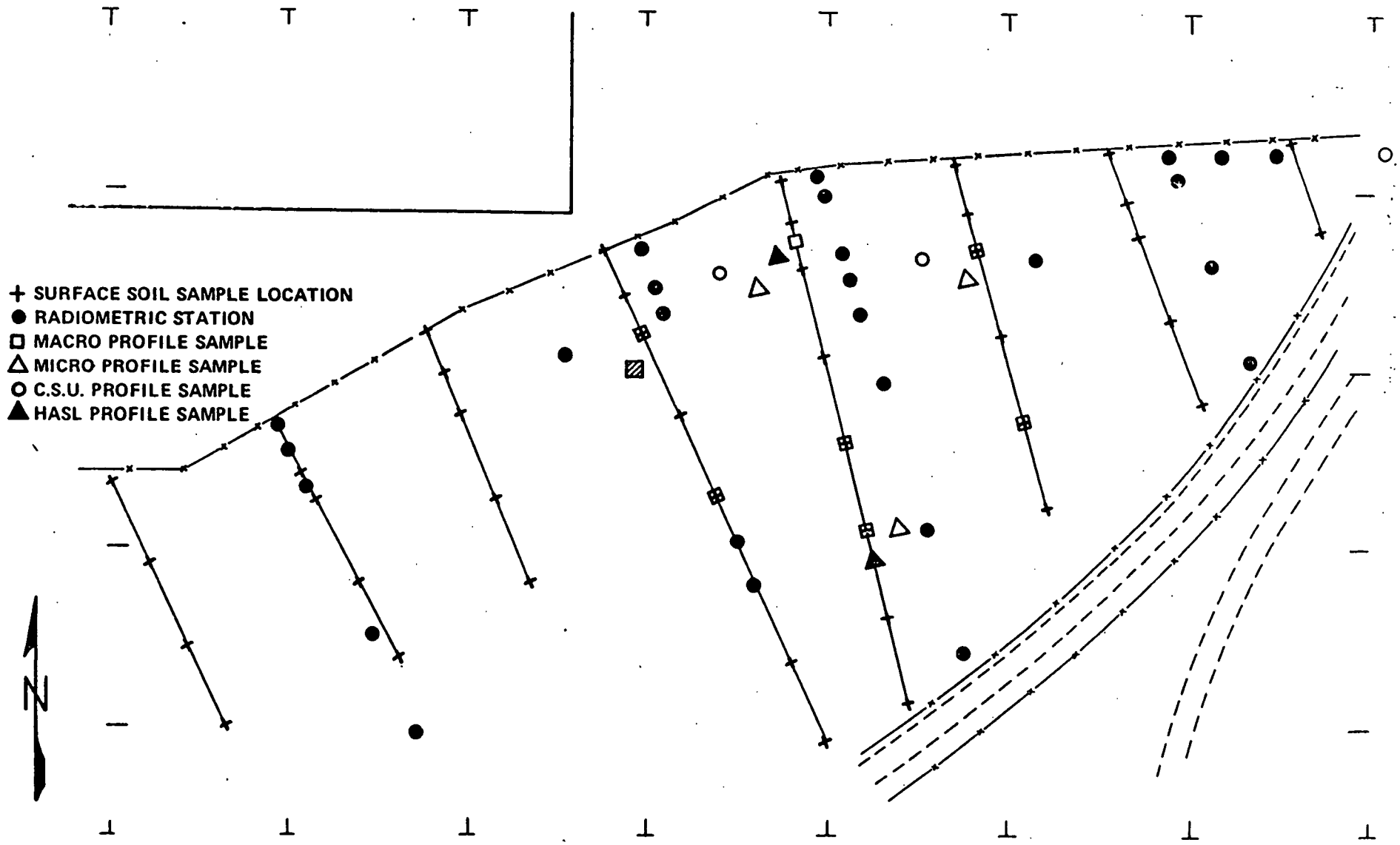


FIGURE 3 LOCATIONS OF SURFACE SOIL SAMPLES; SOIL PROFILE SAMPLES AND RADIOMETRIC STATIONS IN AREA SOUTHEAST OF ASPHALT PAD AT ROCKY FLATS.

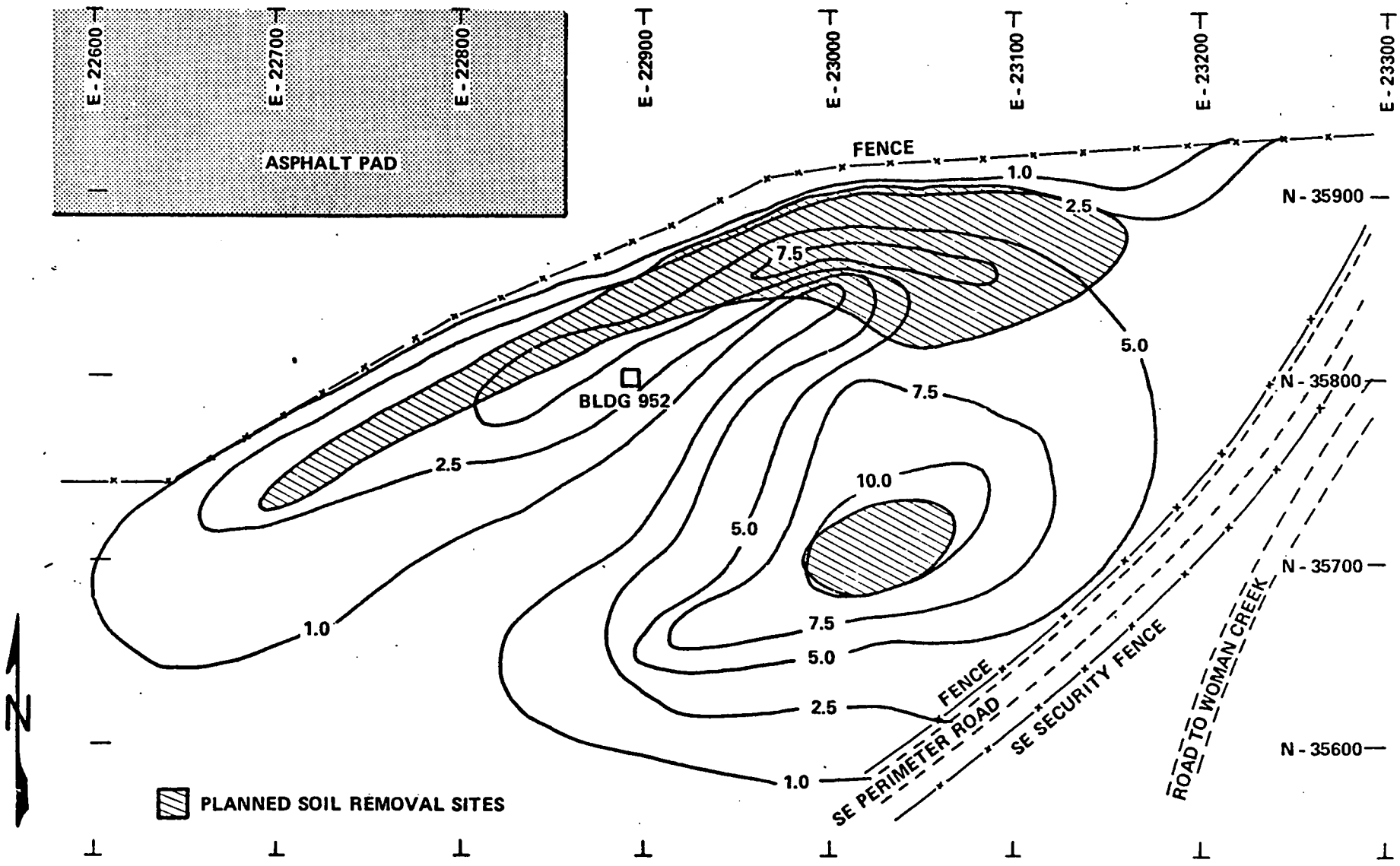


FIGURE 4 AMERICIUM CONCENTRATIONS ($\mu Ci/m^2$) DETECTED BY FIDLER SURVEY IN OCTOBER, 1973

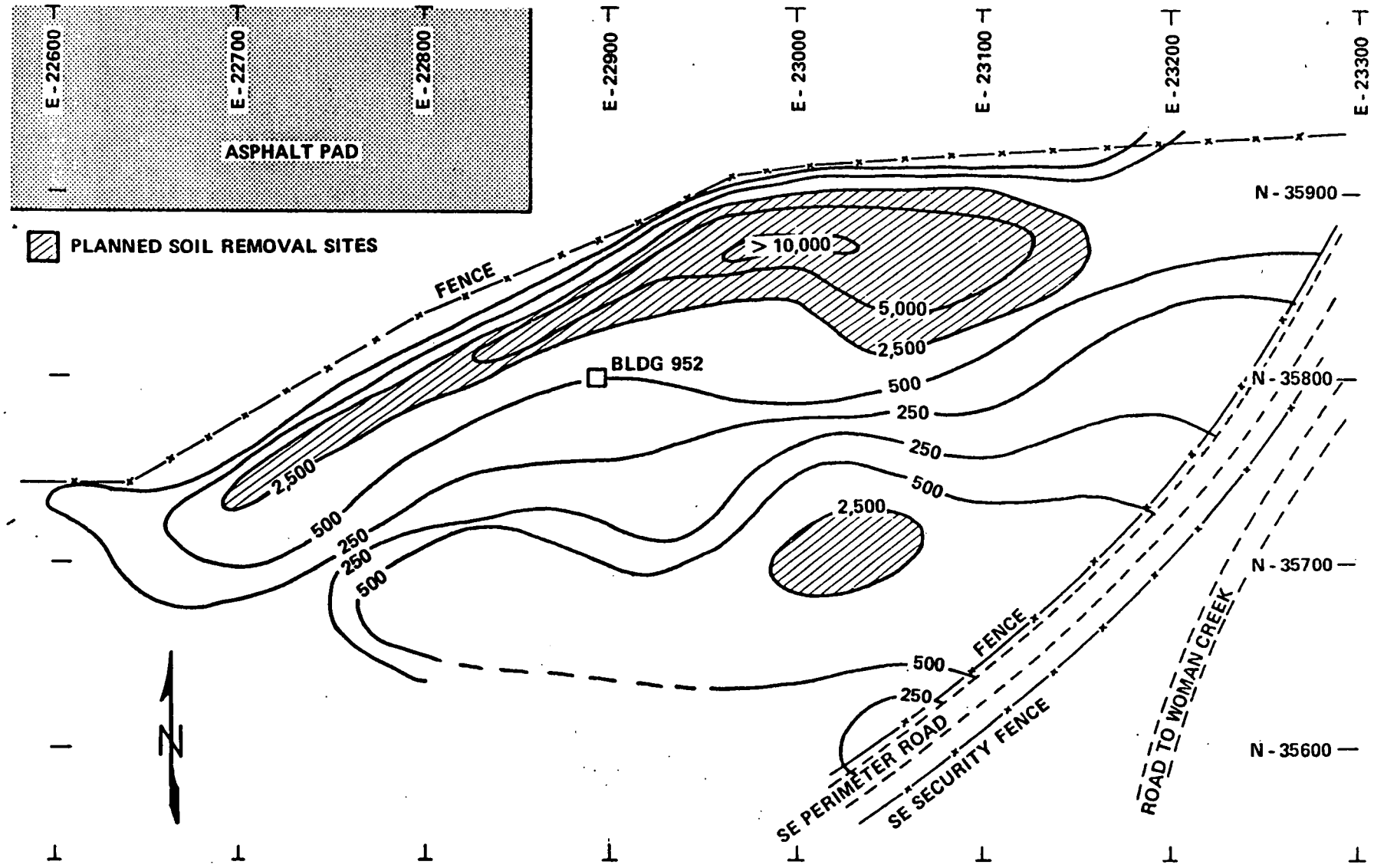


FIGURE 5 PLUTONIUM CONCENTRATIONS (pCi/g) DETERMINED BY RADIOCHEMICAL ANALYSIS OF SOIL SAMPLES COLLECTED IN MARCH 1974.

SCALE: 80 FEET PER INCH
(9.6 METRES PER CENTIMETRE)

Soil macro profile data were obtained from 19 samples collected at 15 cm intervals down to a maximum of 45 cm at seven selected sites. Samples were collected using a 3-in. (7.6-cm) diameter orchard auger. Each 1.5-cm interval was treated as one sample, i.e., air dried, sieved to pass 35 mesh and analyzed for plutonium on a d/m/g basis (dry weight). The results are shown in Table I.

Additional samples collected to date include five micro-profiles (29 samples taken at 0.5 cm intervals), two macro-profiles taken by researchers from Colorado State University (CSU) (14 samples taken at 3 cm intervals),[5] and several samples collected from two trenches 1.5 by 0.9 by 0.6 m by personnel from HASL. The results obtained from the first two sets of samples are included in Table I. Analytical data on the HASL profiles are not available. Some preliminary radiometric results by Ge (Li) diode spectrometry indicate that over 80% of the americium-241 (daughter product of plutonium-241) is contained within the top 9 cm of soil.[6]

The total available data from the soil profiles appear to be in general agreement. The plutonium is apparently distributed somewhat erratically down to a depth of at least 45 cm. The highest concentrations (greater than

TABLE I

SOIL PROFILE DATA

Sampler*	Sample Identification	Depth Zone (cm)	Plutonium Concentration (d/m/g)
Dow (Illsley)	4B	0 -15	980
		15 -30	150
		30 -45	95
	4D	0 -15	150
		15 -30	27
		30 -45	16
	5B	0 -15	1,140
		15 -30	905
	5D	0 -15	48
		15 -30	16
		30 -45	16
	5E	0 -15	155
		15 -30	105
		30 -45	28
	6B	0 -15	1,980
		15 -30	1,820
	6D	0 -15	420
		15 -30	1,820
		30 -45	960
Rockwell (Volk)	M1A	0 - 0.5	27,000
		0.5- 1.0	35,000
		1.0- 1.5	50,000
		1.5- 2.0	18,000
		2.0- 2.5	28,000
		2.5- 3.0	13,000
	M1B	0 - 0.5	8,000
		0.5- 1.0	24,000
		1.0- 1.5	15,000
		1.5- 2.0	20,000
		2.0- 2.5	11,000
		2.5- 3.0	14,000

TABLE I (Cont.)

Sampler*	Sample Identification	Depth Zone (cm)	Plutonium Concentration (d/m/g)
Rockwell (Volk)	M2A	0 - 0.5	14,000
		0.5- 1.0	43,000
		1.0- 1.5	36,000
		1.5- 2.0	38,000
		2.0- 2.5	13,000
		2.5- 3.0	14,000
	M2B	0 - 0.5	29,000
		0.5- 1.0	49,000
		1.0- 1.5	1,400
		1.5- 2.0	24,000
		2.0- 2.5	12,000
		2.5- 3.0	28,000
	M3	0 - 0.5	18,000
		0.5- 1.0	4,400
		1.0- 1.5	14,000
		1.5- 2.0	2,900
		2.0- 2.5	1,200
CSU(5)	C1	0 - 3	13,873
		3 - 6	3,012
		6 - 9	2,029
		9 -12	409
		12 -15	799
		15 -18	604
		18 -21	157
	C2	0 - 3	11,502
		3 - 6	1,255
		6 - 9	1,113
		9 -12	396
		12 -15	251
		15 -18	ND
		18 -21	218

*The samplers are identified by company or institution and in parenthesis by individual.

5000 d/m/g) were found in the top 3 cm. It is anticipated, however, that any attempt to remove the plutonium contaminated soil will require excavation to an average depth of 15 cm. This action will allow for unavoidable mixing of clean and contaminated soil and assure removal of soil containing more than 250 d/m/g plutonium (113 pCi/g) from the areas outlined in Figure 5.

Differences noted in the profile data given in Table I can be explained by the fact that different objectives were guiding the sample collection in the three cases. The major purpose for collecting the seven deep profile samples was to determine the maximum depth of plutonium migration over a significant portion of the area. Relatively thick (15 cm) and large (1 to 2 kg) samples were taken as being the most representative of the total inventory. The 29 micro-profile samples were taken as part of the biological uptake study and were both small in size and thin (0.5 cm) in depth. The samples collected by CSU and HASL are believed to most accurately represent the typical vertical distribution of plutonium in the soil of this area. Unfortunately, only two sets of profile data are available from CSU. The data do indicate, however, that 72% of the plutonium is in the top 3 cm and only 3% is deeper than 15 cm.

The two maps shown in Figures 4 and 5 indicate reasonable correlation in areal distribution between americium, as detected by FIDLER survey, and plutonium, as measured by radiochemical analysis of soil samples. The planned excavation sites are shown as shaded areas on both figures. These sites include approximately 2000 square metres contaminated with plutonium in excess of 5000 d/m/g (2252 pCi/g). Assuming an average depth of 15 cm, the 300 cubic metres of soil could contain as much as 0.35 curie or 62.5% of the estimated plutonium in the soil southeast of the asphalt pad. Extending the limit out to the 1000 d/m/g isopleth would include about 75000 square metres for a soil volume of 1135 cubic metres containing about 0.51 curie, or 91% of the total plutonium.

During the summer of 1975, follow-on flights by the ARMS group from EG&G were made using improved instrumentation with lower sensitivities. Preliminary results for the areas of concern are not significantly different from those obtained in 1973.[7]

A detailed radiometric ground survey of the southeast site is currently underway by Rockwell. This survey is being performed with a hand-carried sodium iodide detector and instrumentation calibrated to detect low energy x-rays from

plutonium. The results of the survey will be available for guidance during planned soil excavation. Data collected to date do not change the appearance of radioactive isopleths as shown in Figure 4.

In February 1974 a public briefing was held at the Rocky Flats Plant for the Governor of the State of Colorado and other state officials. In that briefing the contaminated zone was described as an area of concern. During the briefing and in releases to the press which followed, ERDA made a commitment to examine techniques to further stabilize or remove the contaminated soil. Although there is not a public health hazard nor is one anticipated, there is a potential environmental problem. It is in the best interests of the environment and public relations with surrounding communities to remove the contaminated soil.

Personnel from the Colorado State Department of Health (CDH) have been advised of the plan to remove some of the contaminated soil and agree that the potential for future environmental problems warrants the safe removal of the soil as soon as practical.[8]

Excavation experience and exposure data were obtained in 1975 during a training program and a special excavation

project for personnel from HASL to obtain the previously mentioned soil profile samples. The trial excavation was performed on May 5, 1975 in an adjacent analog area about 350 metres northwest of the contaminated area. All excavation and packaging operations were performed inside a floorless metal building, equipped with a door, window, High Efficiency Particle Aerosol (HEPA) filter and air mover.

After the excavation and removal of about 0.08 cubic metre of soil, the training program was terminated. The plutonium concentration in air sampled 5 metres from the excavation building was 0.00004 pCi/m^3. This is comparable to the local background concentrations of 0.00003 pCi/m^3.

On May 13 and 14, 1975, representatives from HASL, with the aid of Rocky Flats personnel, excavated two trenches in the contaminated area, utilizing the same metal building and techniques as employed in the training program. Stabilizing the soil with water was not required because rainfall on the previous day eliminated any dust problem. All other health and safety rules and precautions were observed.

Eight 55-gallon drums of soil were removed from the two 1.5 by 0.9 by 0.6 m trenches. Subsequent analysis of the

high volume air sampler located outside indicated a concentration of plutonium of 0.00258 pCi/m^3. This value is the same magnitude as the annual averages for permanent air samplers in the vicinity, namely 0.001 to 0.003 pCi/m^3. The results from a low volume air sampler located inside the excavation building were 0.09 pCi/m^3 on May 13 and 0.002 pCi/m^3 on May 14 for a total alpha activity. The relatively low value for May 14 can be explained on the basis of improved handling techniques after one full day's excavation experience and a more dust-free soil in this area as compared to the area excavated on May 13. These results should be compared with the soluble Radioactivity Concentration Guide (RCG_a) for controlled areas which is 2.0 pCi/m^3.* It was concluded that the excavation in the contaminated area created no hazardous conditions for either the industrial workers or the off-site population.

Assessment of the current stability of the area is based on Rockwell air monitoring results from instruments located immediately east (the prevailing downwind direction) of the area. Figure 6 shows a typical wind rose for Rocky Flats. Air sample results have not shown higher than 11% of the RCG_a for soluble plutonium-239 in a controlled area.

*Standards for Radiation Protection, U.S. Energy Research and Development Administration, ERDA Manual Chapter 0524, Table I.

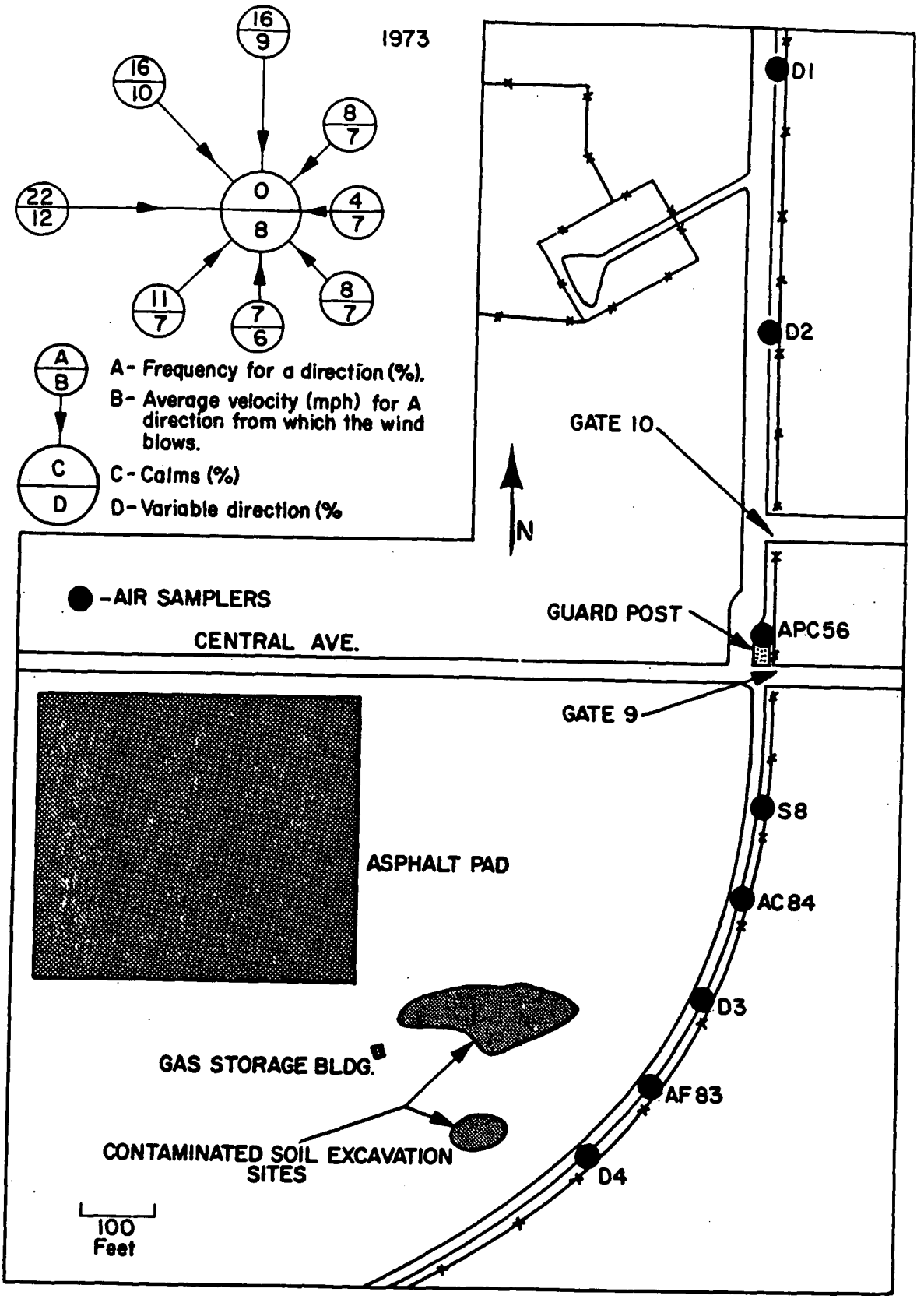


Figure 6 Location of the AI and CDH Air Samplers east of the contaminated soil excavation sites.

Additional air monitors maintained by the Colorado Department of Health (CDH)[9] and HASL[10] likewise have not shown amounts of airborne plutonium greater than the RCG_a. Figure 6 shows the relative locations of the Rockwell and CDH air monitors. The HASL No. 1 monitor is located beside Rockwell Station S-8. Air monitoring instrumentation consists of a vacuum pump and filter paper collector which samples about two cubic feet of air per minute on a continuous basis. The Rockwell and HASL filters are analyzed weekly for total alpha activity and composited for monthly plutonium analysis.

The average alpha radioactivity concentrations from nine stations are shown in Table II. Stations D-4 and AF-83 are located immediately downwind from the contaminated areas. The other stations are located east and northeast of the areas at a maximum distance of 800 ft (244 m). The results are for average annual plutonium concentrations of plutonium-239. It should be noted that all of the annual averages are significantly below the recommended Radioactivity Concentration Guide.

Additional data from air samplers located at greater distances from the contaminated areas also indicated that there is no hazard from airborne plutonium. HASL has one

TABLE II

AVERAGE ANNUAL PLUTONIUM CONCENTRATIONS IN AIR*
AT THE EAST SECURITY FENCE OF THE ROCKY FLATS PLANT
(picocuries per cubic metre)

Colorado Health Department Stations[9]

Station Code	1973	1974
D1	0.0007**	0.0004
D2	0.0006	incomplete
APC56	incomplete	0.0004
D3	0.0029	0.0038
D4	0.0032	0.0013

Rockwell Stations[11,12]

Station Code	1973	1974
S-8	0.005	0.003
AC-84	no data	0.001
AF-83	no data	0.001

HASL Station[10]

Station Code	1973	1974
No. 1	0.0021	0.0018

*RCG_a for soluble plutonium-239 in a controlled area is 2.0 pCi/m^3 and in an uncontrolled area is 0.06 pCi/m^3.

**The results are for averages of monthly composite samples collected during the indicated year. The units are pCi/m^3 plutonium-239.

monitor located 0.5 mile (0.8 km) east of the plant, and another 1.5 miles (2.4 km) to the east at the government property line. Another station (No. 3) located 4 miles (6.4 km) west of the plant was removed in 1974. Annual averages for 1973 and 1974 from these stations plus those for Salt Lake City, Utah are given in Table III. Rockwell has established air sampling stations surrounding the plant site boundary at points accessible to the general public. Data from these stations are also presented in Table III.

It is noted from Table III that the annual averages for HASL data are greater than Rockwell data by a factor of about two at the same location (HASL No. 2 and Rockwell S-32). The only explanation for this difference is a difference in sampling techniques such as height above ground surface, station housing design, and air pumping rates.

It can be seen that some of the air monitors at Rocky Flats yield slightly higher annual concentrations of plutonium than the one station at Salt Lake City. Most of the results, however, are of the same order of magnitude, except for HASL site No. 4 which is on government property only 0.5 mile east of the plant security fence. There the

TABLE III

AVERAGE ANNUAL PLUTONIUM CONCENTRATIONS IN AIR SURROUNDING ROCKY FLATS

(picocuries per cubic metre)

ERDA-HASL Stations[10]

Site	1973	1974
2 (East 2.4 km)	0.000118	0.000101
3 (West 6.4 km)	0.000027	0.000127
4 (East 0.8 km)	----	0.000802
Salt Lake City, Utah	0.000024	0.000066

Rockwell Stations[11,12]

Site	1973	1974
S-26 (West 2.4 km)	0.000041	<0.000046
S-27 (Northwest 3.6 km)	0.000049	0.000192
S-28 (Northwest 4.8 km)	<0.000050	0.000041
S-32 (East 2.4 km)	<0.000065	0.000053
S-33 (Southeast 3.6 km)	<0.000051	0.000050
S-34 (Southeast 4.8 km)	<0.000063	0.000040
S-35 (South 2.4 km)	<0.000057	0.000047
S-36 (Southwest 3.6 km)	<0.000043	0.000041
S-37 (Southwest 4.8 km)	<0.000063	0.000047

NOTE: The RCG_a for soluble plutonium in ambient air accessible to the population at large is 0.02 pCi/m^3.

average plutonium concentration for 1974 was 0.000802 pCi/m^3 about 30 times background, 8 times the value 1 mile further east and less than one-third the value adjacent to the contaminated area. The important conclusion that can be drawn from the data in Table III, however, is that the ambient air at sites 2 to 4 miles east of the Rocky Flats Plant does not contain significantly more plutonium than the air south or west of the plant. This conclusion is subsequently referred to in discussing the need for excavating an on-site plutonium-contaminated soil. It is stressed that the reason for removal is not to reduce plutonium concentrations in air available to the general public since they are not being affected by plutonium contained in the soil. Reasons for removal are, therefore, related to elimination of the long term potential of plutonium availability for future mobilization and migration.

Calculations of dose assessments from these air concentrations have been made. The results for the same nine stations are shown in Table IV. It was assumed that a person would be standing near the station for eight hours per day, 260 working days per year, without the use of a respirator or other protective devices. A typical calculation of dose is as follows:

TABLE IV

CALCULATED INTERNAL DOSAGE*
FROM AIR IN REM PER YEAR

Colorado Health Department Stations

Station Code	1973	1974
D-1	0.005**	0.003
D-2	0.004	incomplete data
APC56	incomplete data	0.003
D-3	0.022	0.028
D-4	0.024	0.010

Rockwell Stations

Station Code	1973	1974
S-8	0.038	0.022
AC-84	--	0.008
AF-83	--	0.008

HASL Station

Station Code	1973	1974
S-8	0.016	0.014

*Note that the maximum recommended lung dose for occupational workers is 15 rem/year and for an individual in the general population is 1.5 rem/year, as per the Standards for Radiation Protection, U.S. Atomic Energy Commission, AEC Manual Chapter 0524.

**Calculated rem/year from data in Table III.

$$\text{DOSE} = \text{STANDARD} \times \frac{C_{avg}}{RCG_a}$$

Where the STANDARD = 15 rem/year, the RCG_a = 2.0 pCi/m³ and using the maximum average annual concentration from Table II (e.g. Station APC56) so that C_{avg} = 0.003 pCi/m³. Then,

$$\text{DOSE} = 15 \text{ rem/yr} \times \frac{0.003 \text{ pCi/m}^3}{2.0 \text{ pCi/m}^3}$$

$$= 0.0225 \text{ rem/yr}$$

Thus, the maximum annual occupational dose received by a worker who was employed continuously in this area would be less than 0.03 rem. This calculation is based on the most restrictive standard by assuming the plutonium-239 involved in the exposure is in a soluble form. This is a commonly accepted conservative approach and the values in Table IV were calculated in this manner. If the assumption had been made that the plutonium is in an insoluble form then the RCG_a would be 40.0 pCi/m³ and the calculated DOSE near Station APC56 would be less than 0.001 rem/year, i.e., approximately 20 times lower.

Excavation of the contaminated soil is not expected to change the plutonium-in-air concentrations downwind from

the site. Since the current plutonium concentrations in air at the plant boundary are at background levels, reduction of the air concentration is not a reason for the cleanup.

B. Proposed Action

The proposed action is to remove a layer of plutonium contaminated soil from the shaded area shown in Figure 5 and replace it with clean topsoil. The contamination level in these areas exceeds 5,000 d/m/g (2.25×10^{-9} Ci/g) in the top five centimetres of soil. The objective is to remove the soil until the plutonium concentration is below the limit of detection of the FIDLER instrument set up to measure the 60 keV gammas from ^{241}Am. The limit of detection for the FIDLER corresponds to a plutonium concentration of approximately 250 d/m/g of soil, which is less than a proposed standard of 500 d/m/g for plutonium in soil in uncontrolled areas.[13]

The guidance level specified for this project is appropriate only to circumstances at the Rocky Flats Plant at the present time and is based on interpretation of the "as low as practicable" concept. Use of this guidance level at Rocky Flats is not to be construed as endorsement or denial of any proposed standard for plutonium concentrations in soil.

Soil profile analyses (Table I) indicate that the objective of removing the plutonium contaminated soil to a level less than detectable by the FIDLER instrument can probably be accomplished by removing an average of 15 cm of soil. The actual depth of soil removal will be determined during excavation. The excavation will generate approximately 10,500 cubic feet (300 cubic metres) of contaminated soil and will require approximately 1500 55-gallon waste drums for shipment to the ERDA waste disposal facility in Idaho.

Since the contaminated soil near the asphalt pad is within the plant security fence and access to the area is restricted to authorized personnel only, it is planned to remove soil only in areas contaminated above 5,000 d/m/g. This level was arbitrarily selected based on cost and practicality of removal. An estimate of the cost for the planned operation is as follows:

Personnel	$ 76,000
Materials	41,000
Shipping	18,500
Support	13,000
Contingency	16,500
	$165,000

The cost to remove soil within the 1000 d/m/g contour is estimated to be $825,000. When ERDA and EPA adopt soil standards for plutonium contamination, Rocky Flats will comply with these standards. Removal and disposal of lower levels of plutonium-contaminated soil may become more practical after completion of current research on separation techniques.

The removal is expected to take approximately 30 man-months and will begin in the spring of 1976. The excavation will be performed by closely supervised laborers who will be trained in excavating and health physics procedures in a noncontaminated analog area. The training program will be based on experience gained in trench excavations during May 1975. The training excavation will also provide an opportunity to improve and perfect the techniques for dust suppression and to determine the degree of soil resuspension that can be expected.

Rocky Flats Health Sciences Department will provide protective clothing and respiratory protective equipment to all personnel participating in the project. This equipment will be worn during excavation and packaging of the soil. Health Sciences will also assure compliance with all appropriate health physics precautions and supply radiation

monitoring service. All individuals participating in the soil excavation project will be required to shower and change at the end of each work shift, and they will be provided all the Rocky Flats radiation dosimetry services, including urine assay, whole body counting, and radiation exposure badges.

The primary resuspension control will be a small floorless metal building. This building, about 8 feet by 16 feet, equipped with a door, window, HEPA filter and air mover, will serve as a shelter over the immediate digging area. This building was used successfully for the excavation of two trenches in the contaminated area by personnel from HASL.

A plywood walkway will be installed between the digging site and the noncontaminated roadway to provide controlled access. The walkway will be used to move soil, equipment and personnel into the area. It will be checked periodically for spread of contamination.

In addition, dust palliatives will be used to control resuspension during and after the operation. Examples of these control measures are spraying the area with water periodically and using soil stabilizers. To ensure that

the palliatives are effective, continuous alarmed particulate air monitors will be operated in the immediate area of the excavation. It is planned to modify or cease excavation and apply dust palliatives if the air concentrations detected by the air monitors exceeds the RCG_a in ERDA Manual Chapter 0524, Table I.

Portable air samplers (2 cfm) will be located inside the excavation building and operated continuously during the excavation and removal operations. The results will be used to determine potential personnel exposure rates, even though the actual workers in the building will be protected with respirators. Several high volume (40 cfm) "Staplex" portable air samplers will be located outside the building at probable downwind directions. These samplers will be operated continuously during the lifetime of the project and the resultant data will be used to determine the amount of airborne plutonium released during the operation. In addition, various air and dust samplers and measuring instruments will be installed.

Weather observation and prediction will be an important part of this project. Rocky Flats weather observations

are made at a station located about 4600 feet from the area of concern. A temporary wind direction and velocity measurement system will be installed immediately adjacent to the area of excavation. Precipitation at Rocky Flats is light with an annual average of 16 inches. The maximum yearly total recorded over a 21-year period was 25 inches in 1969. The minimum for the same period was 8 inches in 1954. The greatest amount for one day was 3.4 inches in May 1969.

High-force winds gusting to velocities of approximately 105 miles per hour have been recorded at Rocky Flats on four occasions in 17 years; March 1956, January 1959, January 1972, and November 1972. The 21-year average of the mean wind velocity is eight miles per hour. The highest velocity and most sustained high-force winds have occurred during the period October through May. The winds at Rocky Flats, although variable, are predominantly from western quadrants. Over a 17-year period (1953 to 1970), west winds occurred 25% of the time and more than 50% of the winds had a westerly component.

Since the soil excavation is planned for the summer months, the major weather concerns are rain storms and gusty winds. Summer forecasts of these two conditions are not feasible

on a day-to-day basis for this local area. There are available, however, climatological frequency charts of periods of wind velocity equal to or greater than 20 miles per hour for periods greater than two hours. These charts were prepared by L. W. Crow, a certified consulting meterologist, from historical data from the Rocky Flats weather station.[14] Crow recommends June as a typical low-wind month (Appendix II). Gusting winds are fairly common in the afternoon during the period of the planned excavation. The direction and intensity of these winds is unpredictable, but they have very short duration. Since all soil handling operation will be conducted inside a metal building, such intermittent wind conditions should not create any hazardous situation. If winds become persistent, at velocities greater than 10 to 15 miles per hour (16 to 24 km/hr), operations will be halted. Thunderstorms at Rocky Flats usually occur in the afternoon and are preceded by the buildup of cloud formations which should provide adequate warning. Each cessation of excavation will be immediately followed by appropriate soil stabilization measures.

Contaminated soil will be excavated from one small area at a time and areas will be resurveyed using a FIDLER to determine if detectable contamination levels remain in the soil. Excavation will continue until the contamination levels

are below detectable. The area will then be filled with clean topsoil. After removal of the building, each excavated area will be fertilized, seeded, and irrigated.

Immediately outside the security fence in a direction southeast of the excavation sites and at a distance of approximately 150 feet, lies the nearest edge of an area under intensive study by the Colorado State University Department of Radiology and Radiation Biology.[5] This area is valued as a site for the study of plutonium-239 in the environment. The studies are funded by the ERDA's Division of Biomedical and Environmental Research (DBER) and include such aspects of plutonium in the environment as mechanical transport, uptake in biological systems, solubilization, and movement among trophic levels in the food web.

Since the area is providing valuable information on plutonium in the environment, with approximately four years work completed in a projected six-year study, there is concern that during the excavation some contaminated soil will be blown into the study area. Present plans call for excavation of the contaminated soil during calm periods inside a metal building. These plans will be carried out under careful supervision and should assure minimal adverse impact to the study area.

C. Anticipated Benefits

Personnel at Rocky Flats and the Colorado State Department of Health agree that there has not been any evidence of danger to the environment as a result of the contamination in the area southeast of the asphalt pad.[8] This evaluation is based on air and water sample data collected by Rockwell, HASL, and the Colorado Department of Health; however, only removal of the contaminated soil can absolutely insure against potential redistribution of the plutonium by severe weather action. Since the area is viewed by the public as a potential health hazard, removal of the most elevated levels of contaminated soil will alleviate this concern. In addition, removal would be in keeping with the "as low as practicable" philosophy.

In addition to the anticipated benefit of removing soil containing plutonium, the experience gained by Rocky Flats personnel in soil removal along with the environmental effects information gathered before, during and after that operation would be of value. The experience gained will be useful in evaluating the removal of other contaminated soils. The project final report should serve as a valuable reference source of any future activities.

Through the process of reclamation, noncontaminated areas of soil will be surrounded by contaminated soil. One benefit of this removal process will be the opportunity to study future transport, if it occurs, of plutonium from the outer contaminated areas to the inner noncontaminated area.

III. ENVIRONMENTAL IMPACT

The movement of personnel and equipment onto the mixed prairie grassland will temporarily disrupt the succession of vegetation in the immediate area. In addition, once disturbed, the soil becomes more susceptible to wind and water erosion. This condition is anticipated in both the planned excavation area and any access routes used for movement of personnel and equipment; however, care will be taken to keep the movement to the minimum required for successful contaminated soil removal.

The liberal and widespread application of dust palliatives is expected to effectively control soil resuspension after excavation and filling. It is anticipated that Coherex will be the primary soil stabilizer used. Coherex is manufactured by the Golden Bear Division of Witco Chemical Company. It is a non-volatile emulsion consisting of 60% semi-liquid natural petroleum products and 40% wetting agents. A water solution (1 part Coherex to 4 parts water) is applied at a concentration of 0.5 gallon per square yard. Coherex has been successfully used in a variety of soil stabilization projects in Colorado[1,15] and elsewhere.[16] It does not affect the growth of vegetation and it is nontoxic.[17] The solution is applied with a spray nozzle at low pressures from a mixing tank. A second stabilizer, J-197, will be available for use

if needed. J-197 is produced by the Dowell Division of Dow Chemical U.S.A. It is a poly-acrylamide, which is a nontoxic plastic product similar to surfactant chemicals and thickening agents and it does not affect vegetation.[1] It is mixed with water and applied at a rate of about 40 pounds per acre from a mist spray nozzle. The anticipated results from the use of one or both dust palliatives will be the absence of any soil resuspension after excavation and rehabilitation operations.

Additional soil control measures after soil removal will include revegetation of the area with native grasses. This operation will consist of adding four inches of clean topsoil, hydroseeding with a water slurry of grass seed, fertilizer and mulch, and applying a chemical soil stabilizer to prevent erosion during grass germination and initial growth.

As each excavated area is backfilled with topsoil and seeded, it will be necessary to irrigate that area. It is now known exactly what effect irrigation will have on the adjacent areas. The adjacent areas have some grass cover, however, and irrigation will most likely enhance the growth. Careful controls, such as application of excelsior matting, will be used to prevent erosion of the soil from occurring. Several years' exposure of the present area to natural weather conditions, including a 25-year storm in May 1969, has shown no visible signs of detrimental erosion. A Rockwell geologist considers

the slope stable, since it has been rebuilt and compacted; therefore, the slope is not expected to slump in the event of a 100-year storm which could yield as much as 3.7 inches of rainfall in 6 hours.[18] Whether or not a 100-year storm would result in visible signs of erosion is not known; however, the stability of the site precludes severe erosion from occurring during normal storm situations.

Careful irrigation of the newly seeded area should not have significant environmental impact. According to C. L. Williams (Appendix III), "Grass can be established if the proper procedures are followed. This has been demonstrated with seedings made in prior years. It would probably be necessary to use topsoil and irrigation water during the establishment period. Other less expensive items requiring consideration would be proper selection of grass species, fertilizer, equipment, time of seeding, and management. (Ed. note: Approximately two years after the excavation, the area should have recovered to a self-maintaining state and require no further irrigation or treatment.)

"If climax species are seeded at the proper rate, they will continue to grow indefinitely. There is no danger of their dying out and a future plant succession having to occur. After many years, perhaps 50, the area will approach the climax community and there would be little chance for undesirable plant encroachment and establishment."

IV. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The major, unavoidable, adverse effect from the removal of the contaminated soil will be the temporary disruption of this presently stable site.* With the precautions planned, no health hazards or effects to the surrounding environment are anticipated during the excavation period. Approximately two years after the soil removal, the area should have returned to a self-maintaining state.

A minor adverse effect is the loss of the contaminated soil in its present undisturbed state. The Colorado State University researchers have expressed interest in the preservation of the area as a resource on which to study plutonium in the environment. This interest has waned, however, since the area was defoliated in 1975 (see Appendices IV and V). It is not expected that the research potential of the area will be revived with regeneration of plant growth because the natural succession of plant life has been disturbed. At the invitation of Rocky Flats personnel, DBER-funded CSU researchers have sampled the soil and vegetation prior to project initiation.(5) It is planned to retain at the Rocky Flats Plant approximately 100 cubic feet of the contaminated soil. This soil will be

*See Appendix I.

stored in drums for future research purposes for a minimum of 10 years. Laboratory research on the retained soil will supplement research conducted at the undisturbed site. The less-contaminated soil remaining in place after the excavation will also provide opportunity for research.

V. ALTERNATIVES

The alternatives to the removal of 5000 d/m/g plutonium contaminated soil southeast of the asphalt pad are: (1) take no action and leave the contaminated soil in its present state, (2) cover the contaminated soil areas with asphalt, concrete, or other material, (3) remove all soil containing plutonium down to lower radioactivity levels, such as 100 or 250 d/m/g, instead of 5000 d/m/g, (4) cover the area with soil, sod, or a greenhouse, or (5) postpone the planned removal until additional studies can be made.

In the case of the first alternative of taking no action, the plutonium in the soil could be redistributed by severe weather conditions such as heavy rainfall during an abnormally wet spring. Such conditions are considered to have a remote probability. Taking no action will not alleviate public concern* nor will it fulfill the Rocky Flats assurance to the Governor of the State of Colorado that the stability of the soil would be ensured. It is felt that the methods available will allow safe removal at this time. Leaving the contaminated soil in place does not appear to be a viable alternative since the potential hazard will continue to exist.

*See Appendix VI.

The second alternative, covering the area with impervious material, would provide temporary assurance of stability. The cost of covering the contaminated soil with Gunite-sprayed concrete is estimated to be about one-fifth of the cost of soil removal. Asphalt covering is not practical on this sloping terrain without extensive base preparation, which could cause resuspension of the plutonium contamination into the air. Neither of these methods of covering will eliminate the potential hazard of plutonium nor will they allow the soil to be returned to a state of potential usefulness by the Rocky Flats Plant. Furthermore, leaving the contaminated soil in place is not in keeping with the "as low as practicable" philosophy. Covering the contaminated areas would only add to the material that would eventually have to be removed. This procedure, therefore, does not appear to be a satisfactory alternative.

Removal of soil containing levels of plutonium lower than 5000 d/m/g as recommended by this plan would not be economically feasible at this time. For example, to remove all soil containing more than 1000 d/m/g would require excavation and shipment of about 1100 cubic metres of soil and would cost about $825,000. This action would remove about 91% of the estimated plutonium inventory as opposed to the 62% to be removed at the higher cut-off level. Using lower cut-off levels even more vividly illustrates the diminishing benefits

versus increased costs. To remove all soil containing more than 250 d/m/g would require excavation of about 1650 cubic metres, cost approximately $1,200,000, and eliminate 99% of the estimated plutonium inventory.

To cover the area with soil and revegetate or to resod the area would provide temporary protection at best. The cost of this alternative, including the necessary irrigation system, operation, and maintenance costs over a 10-year period, would range between $20,000 and $50,000, depending on whether or not the entire area was covered. Installation of a greenhouse would probably require two separate buildings because of the size of the area and the nature of the ground surface. The cost for such buildings would be greater than $100,000, and they would have only a 10-year life expectancy. Since Rocky Flats is a high-wind area, the chances for a greenhouse-type building surviving a typical spring windstorm are small. Such a building would not be recommended for use at Rocky Flats. As mentioned under the second alternative, covering the contaminated soil does not eliminate the potential hazard of future plutonium migration nor is it in keeping with the "as low as practicable" philosophy. Furthermore, covering the area with more soil only adds material to that which would eventually need to be removed.

The fifth alternative of further delaying any action so that additional studies can be made has been considered, but it has been adjudged unsuitable. The current "state of the art" for soil removal will allow safe excavation and will not endanger workers or the general public. This was illustrated by the HASL trench excavations in 1975. The coordinated studies that will be done before, during and after the soil removal operations will provide considerable information that should have practical value with regard to handling soil contamination problems. In addition, the remaining contaminated soil, which will not be removed at this time provides adequate opportunities for future studies.

Evaluation of the alternatives discussed above does not delineate a better choice than the proposed removal of all soil containing more than 5000 d/m/g plutonium. This is based on total cost, health and safety of both on-site and off-site populations, and long-term hazard potential of the area. Although the 5000 d/m/g is somewhat arbitrary, it appears as the most appropriate for the particular situation at Rocky Flats. Since neither ERDA nor EPA has established a standard for plutonium in soil, nor does it appear that one will be forthcoming in the near future, it is essential that action be taken as soon as possible to remove the most highly contaminated portion of the soil.

It is concluded that excavation can be performed safely without the release of harmful amounts of plutonium, and that the excavated areas can be restabilized by backfilling with topsoil and reseeding with native grasses. Furthermore, the "as low as practicable" philosophy necessitates the removal of the areas of highest contamination because it is not possible to ensure the stability of this soil from any natural disaster.

VI. RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The long-term effect of removing the contaminated soil southeast of the asphalt pad is the return of that area to a condition of potential usefulness to the Rocky Flats Plant. If ERDA operations were to one day cease, additional soil decontamination would have to be considered in terms of projected land use. These considerations would become part of an overall plan to decontaminate the soil under the asphalt pad in addition to that portion of the surrounding ground area containing plutonium concentrations greater than desirable under the constraints of future plutonium-in-soil standards. Details of such a plan cannot be proposed until a soil decontamination process facility is made available.

The short-term effect of this plan would be the temporary disruption of the vegetation by the excavation process. This would be overcome in approximately two years with seeding, fertilizing, and careful irrigation.

VII. RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROLS

The proposed action of removing contaminated soil southeast of the asphalt pad is not in conflict with any known Federal, State, or local land-use plans, policies, or controls.

VIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The only commitment of resources that could be considered irretrievable by this planned action is the loss of the contaminated soil in its current environment for study purposes. Research by ERDA-supported programs and university researchers would be partially precluded by the soil removal; however, approximately three cubic metres of soil is planned to be retained in drums at the Rocky Flats Plant for research purposes, and a significant area of contaminated soil, surrounding the excavation site, will remain available for research studies. In addition, minor amounts of resources used in the removal operation that could also be considered irretrievable are transportation fuel, drums for storage of soil, and ERDA storage capacity at the waste disposal facility in Idaho.

IX. COST BENEFIT ANALYSIS

The primary benefit resulting from the removal of contaminated soil southeast of the asphalt pad is the assurance that the redistribution of plutonium under severe weather conditions will be minimized. In addition, practical excavating experience will be gained, which will be useful in evaluating other contaminated soil areas having removal potential.

Another benefit is the assurance to the citizens of Colorado that positive actions are being taken to prevent a potential spread of contamination from this particular area.

The primary costs resulting from this action are estimated to be $165,000 for soil removal. If the contaminated soil is not removed, subsequent plutonium redistribution over a larger surface area could increase the eventual removal costs by factors of ten. The plutonium concentrations per unit of soil might be lower, but probably would not be reduced to a safe level by soil dilution.

Based on the above costs and benefits, it is believed that Rockwell should procede with the proposed plan to remove the indicated contaminated soil southeast of the asphalt pad.

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17. "The Coherex Manual for Dust Control," Golden Bear Division of Witco Chemical Corporation.

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APPLICATION OF HERBICIDE TO WINDBLOWN AREA

In anticipation and preparation for removal of the contaminated soil during the summer of 1975, it was decided to apply the herbicide, Ureabor®, to kill vegetation. Ureabor, manufactured by U.S. Borax Company, contains sodium metaborate (66%), sodium chlorate (30%, and bromacil (2%). It is a non-specific herbicide, and it has a typical three-year persistance under the climatic conditions at Rocky Flats. About 150 pounds of Ureabor were broadcast over the 2000 square metres of soil on April 1, 1975.

The herbicide effectively killed all vegetation in the application area by June 1 when it was decided not to excavate the contaminated soil during 1975. To prevent migration of the contamination from the exposed soil surface, a revegetation program was initiated early in July 1975. This program consisted of covering the ground surface with excelsior soil retention mats to control potential erosion. Irrigation water was then applied to leach out as much Ureabor as possible.

After the application of an amount of water equivalent to 30 inches of rainfall, 50 pounds of millet seed were broadcast by hand over the defoliated area. Irrigation was continued to facilitate seed germination, which was successful.

A satisfactory ground cover of millet has been established. This was supplemented by a crop of perennial rye grass in the fall of 1975.

By late September 1975, it appeared that the area had been successfully stabilized with millet. Grasses are continuing to grow, the erosion control mats are still in place and no erosion is apparent. Water in an amount equivalent to approximately 30 inches of rainfall has been applied with the irrigation system. No indications of plutonium resuspension were detected at the adjacent air samplers.

Loren W. Crow

CERTIFIED
CONSULTING METEOROLOGIST

Phone (303) 722-8665 or 756-3971
2422 South Downing Street
Denver, Colorado 80210

April 2, 1975

Mr. Skip Allen
Dow Chemical-Rocky Flats Division
P. O. Box 888
Golden, Colorado 80401

Dear Skip:

I have reviewed the frequency of strong winds and recommend June as a typical low-wind month.

Sincerely yours,

Loren W. Crow CCM

LWC:dd

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 17107, Denver, Colorado

February 5, 1975

Mr. Chuck Illsley
Dow Chemical Company
P. O. Box 888
Golden, Colorado 80401

Dear Mr. Illsley:

This letter is in answer to your inquiry concerning revegetating disturbed sites at Rocky Flats.

Grass can be established if the proper procedures are followed. This has been demonstrated with seedings made in prior years. It would probably be necessary to use topsoil, and irrigation water during the establishment period. Other less expensive items requiring consideration would be proper selection of grass species, fertilizer, equipment, time of seeding, and management.

If climax species are seeded at the proper rate, they will continue to grow indefinitely. There is no danger of their dying out and a future plant succession having to occur.

Please contact our field office in Golden (279-1632) if you desire assistance relative to problems associated with revegetating disturbed areas or other conservation problems.

Sincerely,

Clifford L. Williams
Acting State Resource Conservationist

APPENDIX IV

Department of Radiology and Radiation Biology

Colorado State University
Fort Collins, Colorado
80523

October 14, 1974

Dr. I. Leiir Brisbin
Environmental Programs
Division of Biomedical and
Environmental Research
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Bris:

Per DBER's request, I have prepared this letter to explain in some detail, our reasons for opposing the removal of plutonium-contaminated soil southeast of the asphalt pad at Rocky Flats. While removal may be politically expedient, I do not believe such action would serve the best interests of society, science, or the nuclear industry.

Careful examination and sampling of the area by myself and co-workers in June of this year suggest that the soil is stable and that the plutonium has "weathered in," and I seriously doubt that the plutonium is moving laterally to any significant extent. The fact that the plutonium has been in the soil 10-15 years, that some of it has migrated downward to the 18-21 cm horizon, that the most highly contaminated area is in a topographic lee with respect to the prevailing winds, and that a plant community is established over the area, all support the contention that the contamination is stable in the short run (5-15 yr.). Protection of the contaminated area from vehicles, herbicides, and other forms of disturbance would assure its continued stability. The AEC's recent land purchases around the plant to provide a larger buffer zone should tend to enhance soil stability of the entire area provided the land is managed properly.

Removal of the contaminated soil can probably be done safely, but extreme diligence will be necessary. To protect the workers adequately may prove frustrating, and to completely protect the soil from resuspension during excavation will be very difficult. A water spray will be ineffective in preventing resuspension during a high wind if the surface dries temporarily, and application of too much water will cause gully erosion which could also have undesireable consequences. In the long term, it may prove difficult as well as expensive to revegetate the steeper portions of the area sufficiently to retard erosion. In summary, I feel less plutonium will be dispersed to the environment if the area is protected than if the soil is excavated.

file → PLANTS, LABS., BUILDINGS & LAND

MEDICINE HEALTH & SAFETY

Among the more serious threats to the development of the nuclear industry are the health and environmental questions about the transuranium elements. Our DBER-supported work at Rocky Flats is one of the country's major efforts to learn how plutonium and americium are transported in ecosystems and at what concentrations significant human or environmental risks might be encountered. The thrust of our work to date has been centered on "Macroplot 1" which is about 100 meters downwind from the area being considered for excavation. Should excavation take place and resuspension of plutonium accompany or follow the excavation, several of our study objectives would be compromised or even lost. For example:

(1) The long term fate of the plutonium presently in Macroplot 1 could not be resolved from new Pu from the excavation.

(2) The distribution pattern of Pu in the ecosystem would be disrupted and it would not be possible to separate natural causes from the possibility of resuspension.

(3) Transplanted sod blocks in Macroplot 1 are being studied to evaluate resuspension as a pathway for food chain contamination. Any resuspension of plutonium via upwind excavation would invalidate findings of this study.

(4) Determination of the plutonium inventory by ecosystem compartments requires good estimates of plant and animal biomass through time. Physical denudation and human activity associated with the soil excavation would disrupt local and adjacent animal populations. This could also be detrimental to our study.

In effect, then, the findings of DBER's research investment, which amounts to roughly $420,000 to date for Rocky Flats, could be seriously jeopardized by the planned soil excavation.

Even more serious I feel, would be the loss of the contaminated area itself which is of extreme value for research if left undisturbed. The area is unique in its high level of Pu contamination (up to 50,000 dpm/g in soil), in having "aged, weathered in" Pu, in supporting a natural biotic community, and in being a controlled, but accessible area. Such high levels of soil activity and the "aged" nature of the Pu present the biologist with exceptional opportunities to determine if Pu is ultimately degraded by physical and biological processes to the point that biological or physical transport is enhanced. Fission track analyses of soil samples from the contaminated area show that much of the Pu is in monomeric form and virtually every soil particle contains isolated Pu atoms. This supports the idea that "weathering"

has taken place and it also indicates definite inhalation hazard potential for humans working in that area (particularly people who might be involved in the excavation). Relatively high levels of contamination, in addition to making possible a variety of biological uptake and transport experiments, provide unique opportunity for studies on the physical/chemical nature of plutonium in various biological structures.

If there is sound scientific rationale that the soil should be removed, then the research should uncover such rationale and then the excavation could be carried out with much better justification. Since knowledge on the ecological transport of transuranium elements is so badly needed and so crucial to the emerging nuclear power economy, I must strongly argue that the public interest is best served by considering the contaminated area a research opportunity rather than a political liability.

Sincerely yours,

F. Ward Whicker
Principal Investigator
AEC Contract AT(11-1)-1156

FWW/sf

cc: George Werkema, Dow Chemical, Rocky Flats
Milt Thompson, Dow Chemical, Rocky Flats
Gary Huffman, AEC Area Office, Rocky Flats
William Lamb, AEC Area Office, Rocky Flats

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

OCT 29 1975

Dr. Earl W. Bean
U. S. Energy Research and
Development Administration
Rocky Flats Area Office
P. O. Box 928
Golden, Colorado 80401

Dear Earl:

This is a brief note concerning my recent visit to Rocky Flats. As you well know, my primary purpose for visiting regarded the question of removal of Pu contaminated soil southeast of the asphalt pad near the east gate.

As I discussed with you during my visit, I can no longer support the concept that this particular site offers the potential of being a valuable research site. The variety of treatment to which this area has been subjected would, in my opinion and that of a number of my colleagues, make research results extrapolated from this site to another area very suspect, if not completely invalid. Hence, the consideration of using this site for research, rather than the question of removing the Pu, need receive only brief treatment in the environmental assessment. However, the other issues raised by BER and other reviewers concerning the adequacy of the initial environmental assessment, are expected to receive full consideration in the draft now under preparation.

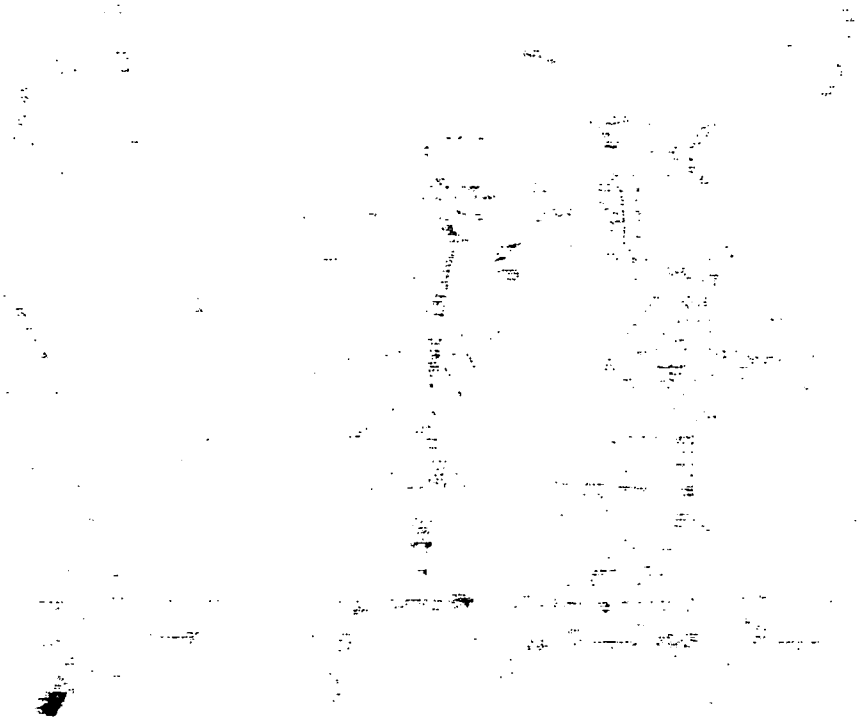
If you desire, I would be happy to more fully comment upon other aspects of the assessment.

Sincerely,

William S. Osburn, Jr.
Ecologist
Environmental Programs
Division of Biomedical and
Environmental Research

APPENDIX VI

The following newspaper clippings are provided as examples of the press and public response to the existance of soil contaminated with plutonium at Rocky Flats.



Rocky Flats To Remove 'Hot' Soil

By Paul Danish

Some of the plutonium-contaminated soil of the Rocky Flats nuclear weapons plant will be removed and shipped to a radioactive wastes depository in Idaho, the Atomic Energy Commission announced Tuesday.

The soil was contaminated some years ago when machine-tool cutting oil containing plutonium leaked out of some barrels stored on the plant site some nine miles south of Boulder.

The particular contamination in question, however, was not discovered until 1974. Some 124,000 square feet of soil are involved. An estimated seven grams of plutonium, or three curies, are thought to be in the soil.

According to AEC spokesman James Nicks the removal of the soil will begin later in the year when the weather improves. It will take a considerable period to complete, since removal will be a "spade and shovel" job. Heavy equipment won't be used, he said, since it might raise dust and further spread the contaminated soil and because it would make monitoring more difficult.

Nicks said the soil to be removed would be continuously wetted down to eliminate dust. He said the workers involved in the project would wear protective clothing.

The material will be placed in steel drums and shipped to the AEC's nuclear waste depository in Idaho.

Nicks said he could not say how much material would be removed, because it had not yet been determined how deep the removal operation would have to penetrate.

The contaminated site is

(See Page 13)

Rocky Flats (Cont.)

(From Page 1)

located south and east of the larger area of contamination, which is where the oil originally leaked from several of the 3,572 drums containing oil contaminated with plutonium cuttings and 1,254 containing oil with uranium cuttings.

The drums had been stored in the open between 1958 and 1967.

The plant is involved in extensive fabrication of triggers for nuclear weapons. The triggers are small atom bombs fabricated from plutonium. The latter substance, apart from being extremely radiotoxic, is highly flamable. Accordingly it must be kept well-lubricated when it is machined or it might burst into flame.

(A 1969 [illegible]

in billionths of a curie, nano-curies, or trillionths of a curie, pico-curies.)

Nicks said the AEC has the question of removing the contaminated soil under the 146,000 square foot patch under study. No decision has been reached, he said, because the AEC has not yet found a suitable, long-term disposal site for large quantities of nuclear wastes.

Clean-up of the spill inder the patch will apparently involve removal of considerably larger quantities of contaminated material than the soil removal scheduled for later this year will.

News of the soil removal is only one of several developments concerning the nuclear weapons plant this week.

Monday, the Jefferson

The hearing is expected to attract a number of critics of the AEC's standards many of whom have contended for some time that the latter are several thousand times above what they should be.

The AEC, the critics maintain, badly underestimated the dangers of long-term exposure to low-level radiation.

Edward Martel of the National Center for Atmospheric Research (NCAR) has said there is reason to suspect the cancer risk from long-term, low-level radiation exposure may actually be greater than the risk from higher doses over a shorter period of time.

In another Rocky Flats development, the Dow Chemical Co., which

Radioactive dirt removal challenged

A group of scientists from Colorado State University has challenged the federal government's plans to remove a vast amount of radioactive dirt from the grounds of the Rocky Flats weapons plant between Denver and Boulder.

Their reason: They want to build an experimental "greenhouse" on top of it in order to study the effects of plutonium contamination on soil, plants and animals.

But the very thought of such an experiment is enough to enrage one Boulder man, Dr. Edward Martell. He insists the continued presence of the contaminated soil in the area poses a threat to the health of the surrounding population.

In question is 124,000 square feet of property on the Rocky Flats site. It was contaminated in the 1960s when storage drums, filled with radioactive machine cutting oil, rusted through and leaked their contents into the soil.

CHEERED BY ANNOUNCEMENT

Martell, a veteran gadfly of the U.S. Atomic Energy Commission (AEC), was one of those who cheered when the agency announced it would start digging up the dirt, putting it in drums and hauling it to a burial site near Arco, Idaho.

As of Jan. 19, the AEC was disbanded and reorganized as two separate agencies. Presumably, the disposal program will move ahead as scheduled under the newly created Energy Research and Development Administration (ERDA).

But the CSU scientists began putting forth their objections within 11 days after the plan was announced Jan. 10 by James Nicks, the AEC's assistant area administration manager.

They showed up Jan. 21 at a meeting of the 11-member Rocky Flats Task Force, which had been set up by Gov. Richard D. Lamm and U.S. Rep. Tim Wirth, D-Colo., to study problems surrounding the controversial nuclear weapons plant.

There, they declared that they wanted the land to stay as it is.

Some of the soil which was contaminated by that past oil spill was covered over by asphalt in 1969. But the rest of it remains open to the elements. In some spots, the plutonium levels exceed permissible limits. Effects on the surrounding land have been severe enough to cause task force members to seek delays in residential zoning nearby.

WORSE TO DIG

But the CSU scientists argued that it might be worse to dig up the contaminated land than to leave it alone.

"We feel," said a report from the group, "less plutonium will be dispersed to the environment if the area is protected than if the soil is excavated."

Neither Nicks nor Martell agrees.

Nicks insisted Friday that the dirt would be watered down before any digging was done. Then it would be removed, slowly, by hand shovels — and only when the wind is "nil." Furthermore, he said, adequate protection would be provided to those doing the work.

Martell, meanwhile, accuses the CSU researchers, who come from that school's radiology and radiation biology departments, of having self-serving motives.

Under the direction of Dr. F. Ward Whicker, the CSU team has been studying the total effect of the Rocky Flats contamination on the eco system downwind of the plant. Their study began in 1972 under an AEC contract which has since cost $420,000. Of this, $125,000 is budgeted in the federal government's current fiscal year.

DISRUPT THEIR STUDIES

Most of this research has focused on an area about 300 feet from the site from which the soil is due to be excavated. And, in their report to the Lamm-Wirth task force, the scientists complained that this excavation would thoroughly disrupt their studies.

The "greenhouse" idea was suggested by the CSU team after they completed their formal presentation to the task force, according to Boulder attorney William Cohen, who represents Wirth at that group's meetings.

Cohen said the researchers told the task force their work would be enhanced by the erection of such an experimental structure on top of the contaminated soil.

Dr. T.F. Winsor, an associate investigator on the CSU research team, said such a structure would "give us a controlled situation to look at the system and see if a significant amount of plutonium is being taken up by plants without being supplied by wind and other elements."

Martell, however, is sharply critical of the CSU researchers. Commenting on the matter in recent days, he termed it "amusing" that the scientists were fearful of having their work jeopardized by excavation of the radioactive soil.

"I think it is much more important that we don't jeopardize the health of the humans living in that area," he declared.

Martel went on to accuse those who wanted the soil in place of being "short sighted and selfish" in their view of the circumstances.

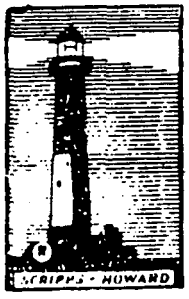
The longtime Rocky Flats critic has estimated that plutonium levels in areas near the plant are so high that the effect on human lungs is as bad as if the individuals had smoked "several packs of cigarettes a day . . . from the day of his birth."

Last year, the U.S. Environmental Protection Agency (EPA) released a study which showed that cattle pastured east of the plant have more plutonium in their lungs than a herd of cattle grazing on the AEC's Nevada test site.

Martell, who was the first person to discover the high levels of plutonium in the Rocky Flats soil, argues that conditions underneath a "greenhouse" would be unnatural and therefore of no validity anyway.

"If people want to study plutonium radiation in soil, they ought to do it at the Nevada test site," he declared.

The task force will meet Feb. 11 in Denver to present its recommendations to Lamm and Wirth. Cohen said Friday that no decisions had yet been reached in regard to this question.



"Give light and the people will find their own way."

Rocky Mountain News

Reg. U.S. Pat. Off

A Scripps-Howard Newspaper

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Enough of halfway measures

RADIATION BIOLOGISTS at Colorado State University have registered opposition to the federal government's plans to dig up and cart away for safe burial 20,000 square feet of plutonium-contaminated topsoil at the Rocky Flats nuclear weapons plant northwest of Denver.

The university scientists are concerned that such a project might — despite precautions — kick up just enough radioactive dust to play havoc with their three-year-old study of plutonium levels in plants and prairie wildlife at a site just downwind of the planned excavation.

And well it might. But when there is a choice between cleaning up the residue from a plutonium spill close to home and forecasting the possible eco-damage of a future spill somewhere in the world, we must opt for the here and now: Let's get on with the digging.

The excavation itself will be only a halfway measure, and is the very least that the Energy Research and Development Administration (ERDA) should do to clean up the nuclear mess made at Rocky Flats by ERDA's predecessor, the Atomic Energy Commission, and its contractor at Rocky Flats, the Dow Chemical Co.

Over the years the AEC's and Dow's response to the plutonium spill has been nothing short of cavalier, considering the potential of airborne plutonium particles to cause lung cancer, and in view of their radioactive half-life of 24,000 years.

According to State Health Department records, Rocky Flats officials knew as early as 1964 that barrels of plutonium-bearing waste oil had rusted through, spilling their deadly contents onto the windswept prairie soil. Only four years later did they decide to pave the immediate area with asphalt and cover the perimeter with a six-inch layer of sand and gravel, on which maintenance trucks were allowed to churn their wheels.

In the meantime, the prairie winds were at work dispersing radioactive particles over acres of land, and insuring that CSU scientists would have plenty of irradiated plant and animal life to study.

Only in 1970, when outside researchers discovered contaminated soil, did the AEC admit to Colorado officials that the spill had occurred, and, at state insistence, fence in the asphalt and gravel area from further traffic.

And it wasn't until 1973 that Rocky Flats officials determined that still more land was sufficiently contaminated to be classified a Radex zone, in which protective gear must be worn to prevent inhalation of radioactive particles.

It is only this recently discovered Radex area which ERDA proposes to excavate and ship to an Idaho site for deep burial. No promises have been made as to the more highly radioactive soil lying beneath the asphalt, sand and gravel, but it goes without saying that the longevity of asphalt falls short of 24,000 years.

If we were convinced that the CSU study would yield information vital in managing future plutonium spills — there have been at least four already since the advent of nuclear weaponry — we would recommend that ERDA blanket the entire affected area with suitable covering until the nearby research project is completed in two or three years.

But even the CSU project's chief investigator admits that any results will be of limited use in assessing the ecological effects of plutonium spills in regions different from Rocky Flats in climate and topography.

That being so, ERDA should start digging, and should commit itself to a timetable for removing the entire contaminated deposit — soil, asphalt and all. Enough of halfway measures.

'Significant' plutonium level found at Rocky Flats

By H. PETER METZGER
News Science Editor

"Significant" amounts of previously unreported radioactive plutonium have been found above ground at the U.S. Atomic Energy Commission's (AEC) Rocky Flats Plant near Golden, the AEC announced Monday.

The government is looking for the best way to cover the soil so the cancer-causing substance isn't stirred up and spread by the wind.

Officials pinpointed 2.85 acres where three curies, or about seven grams, of plutonium are scattered on the ground. Nearby, plutonium leaked from drums of contaminated oil several years ago, but the incidents appear to be separate.

The existence of several burial sites, some containing radioactive wastes and others containing nonradioactive chemicals, also was revealed at a briefing by Bill W. Colston, the AEC's Rocky Flats area manager.

HIGH STATE OFFICIALS

Several high state officials, including Gov. John Vanderhoof, attended the briefing.

Colston's presentation was based on a report on wastes at the nuclear weapons plant prepared by the Dow Chemical Co., which operates Rocky Flats for the AEC. Dow was ordered to produce the comprehensive survey of wastes by Gen. H. C. Donnelly, manager of the AEC's weapon complex headquarters at Albuquerque, as part of the government's announced goal of a "total open-door policy" on environmental problems at Rocky Flats.

The soil contamination was the most significant situation revealed at the briefing. Its magnitude, although not its existence, had caught even the AEC by surprise.

"We always knew that plutonium contamination was there, but we never knew the levels were that high," said James Nicks, an AEC spokesman at Rocky Flats. Although AEC officials didn't say so at the briefing, the original measurements by Dow health physics scientists understated the radioactivity by more than 50 times.

Plutonium is extremely toxic, causing lung cancer when inhaled in even minute quantities. There are no generally accepted health standards for plutonium in soils, but there is enough of the substance on the surface of the 2.85 acres to exceed the amount allowed to remain in the lungs of one person by some 30 million times.

That doesn't mean the plutonium will find its way into people's lungs. Colston said the material "is presently stable and has been for some time." But he acknowledged its presence above the ground constitutes "a potential environmental problem from air movement of affected soil."

In an interview he added, "The quantities of plutonium in the contaminated soil area are certainly of concern to us and significant enough for us to institute prompt action to insure that no off-site releases occur."

The AEC intends to immobilize the plutonium as quickly as it can without stirring it up, Colston said.

'PRIOR EXPERIENCE'

"We know from prior experience that to immediately strip the earth and cover the area, as was done in the past, would stir the material and result in airborne plutonium," he told Vanderhoof. In the interview with the News he said "funds are already available, and we have the time to examine different techniques. Then we will pick the best method and do the job right."

The contaminated area is only 60 feet southeast of a field which once held 3,572 drums of plutonium-contaminated oil (see map, page 61).

As those drums rusted over the years, some 37 curies of plutonium, or about 86 grams, were

(Concluded on page 61)

RFAC

ROCKY MOUNTAIN NEWS 2/5/74

NEWS PHOTO BY HOWARD BROCK

Governor leads tour

Gov. John Vanderhoof, left, led a delegation of officials to the Rocky Flats nuclear weapons component plant near Golden Monday. They heard a report on wastes at the plant. With Vanderhoof are Bill W. Colston, with glasses, area manager of the plant for the U.S. Atomic Energy Commission; Gen. H. C. Donnely, right, manager of the AEC's weapon complex in Albuquerque, and James Hanes, plant manager for Dow Chemical Co.

READ

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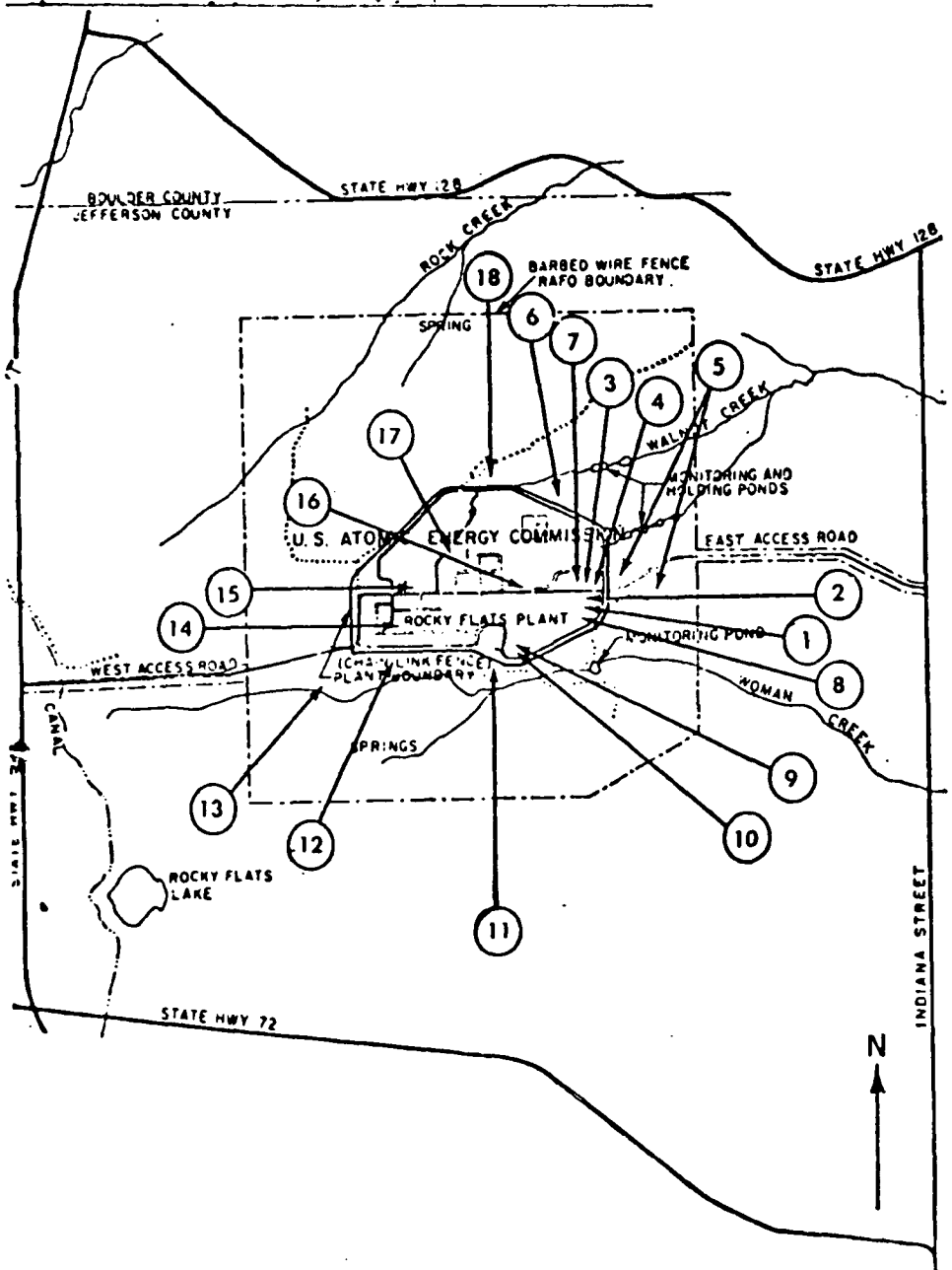

Map shows sites of various wastes at Rocky Flats plant. 1. Contaminated soil containing three curies of plutonium on 2.85 acres. 2. Oil drum storage field. Leakage deposited 37 curies of plutonium in Sixty cubic yards of plutonium-contaminated soil. 10. Contaminated asphalt disposal. Buried 320 tons material contaminated in May 1969 fire. 11. Oil disposal pit. Buried contents of 30-50 drums uncontamin-

'Significant' plutonium level found at Rocky Flats

(Continued from page 5)

spilled on the ground. In 1968 Dow was ordered to cover the place with a three-acre asphalt pad to immobilize the plutonium until a safe disposal procedure could be devised. The incident was announced in 1970.

The newly discovered contaminated area appears to have been caused by a separate but similar leakage years ago, judging by the way the plutonium is spread over the surface. But no one knows for sure.

Doubt was cast on DOW's original estimate of the amount of contamination when the AEC did an aerial survey last spring and summer.

A ground survey by the AEC in September showed that Dow's measurements were in error. A November re-examination by Dow confirmed that fact.

Asked if he thought Dow was guilty of carelessness, Colston said, "Although Dow has been our operating contractor for over 20 years, the ultimate responsibility for anything that goes on around here is the AEC's." Colston has been area manager there since last May.

Accidental releases of radioactivity from the plant have occurred repeatedly since it began making components for nuclear weapons in the early 1950s. The most recent was a spill of tritium, which is radioactive hydrogen, which found its way into Broomfield's water supply last year. At first Dow management denied that the tritium originated at Rocky Flats, according to officials in the U.S. Environmental Protection Agency (EPA). But State Health Department measurements confirmed that the plant was the source.

"We are determined not to have any more surprises, as the tritium was," Colston told the governor.

OTHER CORPORATIONS

AEC officials have refused to publicly discuss the degree to which the government believes Dow is responsible for the "surprises." But, as reported by the News in December, the AEC has decided, for the first time in Rocky Flats' 22-year history, to open to other corporations the right to bid on the contract to operate the plant.

- A field where unusually high nitrate ion concentrations have been caused by seepage from solar, or evaporating, ponds. Its existence hadn't previously been announced.
- An oil burning pit containing the buried residue from burning the contents of 1,083 drums of uranium-contaminated oil.
- An area where the residue from the destruction of 400 to 500 pounds of metallic lithium and small quantities of sodium, calcium, magnesium and solvent compounds is buried. It, too, was announced Monday for the first time.
- A site where 320 tons of asphalt and soil, contaminated in a May 1969 fire, are buried. The AEC estimated that less than one one-thousandth of a curie of radiation is emitted from the 250 cubic yards of material.
- An oil disposal pit containing the contents of 30 to 50 drums of uncontaminated oil sludge.
- The plant's original sanitary landfill containing an estimated 44 pounds of depleted uranium-238 ash buried with normal plant waste and small quantities of surplus chemicals.
- Incinerator ash pits where the ashes of an estimated three ounces of depleted uranium-238, burned with general combustibles, are buried.
- Cooling tower blowdown retention ponds where hexavalent chromium, a corrosion inhibitor, is present. A small amount of [illegible] was destroyed in the easternmost ponds. The ponds are covered with fill.
- An oil burning pit containing the buried residue from the burning of ten drums of oil contaminated with depleted uranium-238.
- An area used for destroying wood [illegible] pallets where no detectable radioactive or chemical contamination has been discovered.
- An area containing scrap metal from the original construction. It, too, appears free of radioactivity or chemical contamination.
- A sanitary landfill started in 1968. An estimated 9 million pounds of uncontaminated waste is buried here annually. From August 1968 until February 1970 about one [illegible] sanitary sewage sludge containing some radioactivity was buried here. Recent surveys [illegible] very low levels of plutonium, tritium and

Plutonium Detection Criticized

Boulder Daily Camera 2/20/75

By BILL JORDAN
Camera Staff Writer

If a Rocky Flats plutonium worker accidently gets a whiff of deadly plutonium and the plutonium happens to be very pure, the detection equipment used by the staff at the nuclear weapons facility will not show a presence of danger.

Equipment used to measure inhalation of plutonium will not produce accurate readings unless the plutonium contains another element, americium. Some plutonium used at the plant is free of americium.

That statement along with several others expressing criticism of Rocky Flats medical and safety procedures were included in a preliminary report released by a task force appointed by 2nd District Rep. Tim Wirth and Gov. Dick Lamm last week.

The medical section of the report, including the statement about the Rocky Flats body count equipment, was prepared by Drs. Arthur Robinson, John Cobb and Edward Gillette.

(Continued On Page 2)

Arthur Robinson is chairman of the Biophysics and Genetics-Pediatrics Department at the University of Colorado. John Cobb is professor of preventive medicine at CU Medical School and Edward Gillette is professor of radiology and radiation biology at Colorado State University.

Rebuttal Being Prepared

Rebuttal is being prepared by officials of the Energy Research and Development Administration, the agency in charge of Rocky Flats operations. James Nicks, assistant area manager for administration at the plant, said in some of the areas covered in the report, the task force didn't find out all there was to know.

Other statements in the report concerning health and safety include:

-Employes of Rocky Flats are concerned that the monitoring of radioactive materials and exposure "may . . . be adequately done by the staff employed by Dow Chemical Co."

Plutonium Detection

(Continued From Page 1)

—The Rocky Flats medical staff, the full capability of responding to a medical emergency in case of a disaster on the site, consists of one former Army physician and eight registered nurses. "None of the medical staff have received a degree or certification in the fields of industrial medicine or public health, both of which are considered desirable for medical staff in an industry of this degree of industrial health risk."

—The one doctor is on call 24 hours a day. "There is no established arrangement for getting a substitute doctor experienced in nuclear medicine in case Dr. Mille. were unavailable in an emergency."

—One of the most serious potential helath hazards connected with the Rocky Flats plant is that of an accident involving transportation of plutonium and other radioactive nuclides. "We were not satisfied that adequate safeguards are maintained to prevent transportation accidents."

The point of a spill of oil carrying significant amounts of plutonium on the plant site has been covered over with asphalt but an adjacent area of high plutonium contamination has not. "It is possible that plutonium from this area may now be subject to resuspension (carried into the air) by gusts or dust devils and may be blown into nearby residential areas in hazardous amounts. "We were not satisfied that adequate study of the factors involved in resuspension of the plutonium in this area has yet been made in order to assess the risk to residents."

Robinson said this week that he didn't think the medical portion of the report contained any bombshells. He said it was intended to be a summation intended to say, "here are the things we found and we ought to learn more about them."

Robinson joined many other critics of the Atomic Energy Commission and its successor agency ERDA for pushing the use of plutonium (as part of the Liquid Metal Fast Breeder Reactor program) when there is little data about the long term effects of exposure to the radioactive substance.

"The major problem is that nobody knows anything about plutonium," he said.

In defense of the plant's body count methods, James Nicks said that while it is true that the major method of detecting inhalation involves tracing gamma rays emitted by americium contained in plutonium, other methods can be employed when it is suspected that little americium was present.

Plutonium is an alpha emitter. The alpha radiation cannot be measured through the normal chest wall.

Nicks explained that americium will "grow over" plutonium in the lungs at a rate of about 20 parts per million per month. According to the report, it takes about 200 parts per million of americium to produce the necessary radiation to be detected through chest walls.

Most Case Delectable

Most of the inhalation cases at Rocky Flats have involved plutonium with sufficient americium to be detectable, Nicks said.

"When we have a possible inhalation of plutonium with low parts per million of americium, we rely heavily on other methods of detection of exposure," Nicks said.

The chief additional method, he said, is bio assay. Employes with suspected inhalations are requested to submit urine and fecal samples.

"Plutonium entering the system will be found in the urine while plutonium cleared from the lungs will be found in the feces. These techniques have been in use since the '40s and are sensative to small fractions of maximum permissible amounts, Nicks said.

Another technique involves the use of x-ray but is less reliable.

About the charge that the employes do not feel safe with the current moinitoring and body count equipment and methods, Nicks said the charge probably came about because one member of the task force is a union representative of the United Steelworkers of America, the union representing Rocky Flats workers.

"I would dare say that is not the feeling of the employes but it has been a statement the union has made," he said.

Concerning the statements that the task force was not satisfied that adequate safeguards are maintained to prevent a transportation accident, Nicks said the installation meets all the requirements of the Department of Transportation. "That's a pretty stiff test," Nicks said.

By early next week, the task force is expected to announce times and places for a series of hearings on Rocky Flats.

Then the panel will prepare recommendations and present them to Wirth and Lamm. The panel also is looking at what can be done about the operations of the Rocky Flats plant should the two elected officials come up with ideas for substantial change.

DOE/RFAO
Bldg 111

Preliminary Report

LAMM · WIRTH

Task Force on Rocky Flats

FEBRUARY 1975

FOREWARD

This report is a brief overview, prepared by the Lamm-Wirth Task Force on Rocky Flats, of operations at the Rocky Flats plutonium facility. Because of the special interests and expertise of individuals appointed to the Task Force, four subgroups were formed (1) Environmental (2) Legal (3) Medical and (4) Occupational.

The report was specifically prepared to describe in some detail those parameters associated with the plant's operation that are of particular concern to the scientific community and the citizenry of the area.

A thorough compilation of reputable and recognized documents pertaining to the operations at the facility were reviewed by each subgroup, as well as numerous verbal presentations presented to the entire Task Force at its regular meetings, including attendance at recent plutonium hearings held by the Environmental Protection Agency. Each subgroup also met with other groups and agencies to collect specific information relative to their field of interest.

The Task Force was appointed and the report was prepared for Governor Richard Lamm and Congressman Timothy Wirth to allow review of current operations, indicating problem areas that need further research and investigation. It is the Task Force' opinion that additional technical and citizen input is needed before any recommendations can be formulated. Therefore, this report is considered a preliminary report.

DOW CHEMICAL COMPANY

(DISINTEGRATIONS PER MINUTE/GRAM OF DRY SOIL)

1971

RFP-ENV-71B

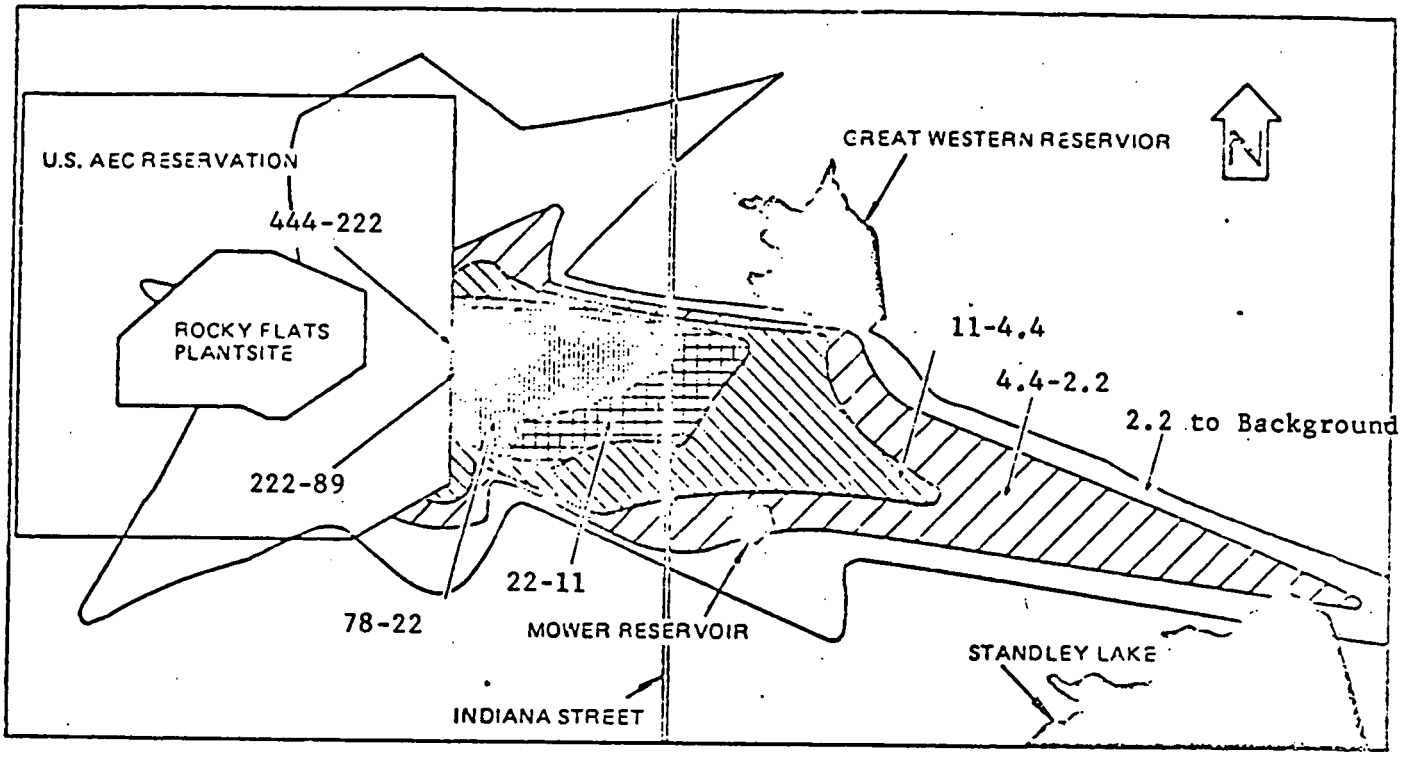

Table X. Surface Soil Analysis: off-site contours.

FIGURE 5: NOTE: These contours were empirically derived by means of a computer curve-fitting program using the method of least squares. This results in a mathematical expression for grid sectors, giving the activity of the plutonium in the soil as a function of radial distance from the on-site barrel-storage area. Three hundred forty-two soil samples were used in generating these contours. Eighteen samples were taken by the Colorado Committee on Environmental Information, 18 by U.S. AEC Health and Safety Laboratory, 306 by the Rocky Flats Health Physics Department. The values assume a soil density of 1 g/cm^3 at a depth of one centimeter.

SOURCE: Annual Report: Environmental Safeguard 1971
Dow Chemical Company, Rocky Flats Division
(RFP-ENV-71B)

to a depth of 1 centimeter (6). Figure 6 shows soil concentrations in the Rocky Flats area in dpm/gm for the first 1/8 inch of dry top soil as determined by the Colorado Department of Health (7). Note that these studies are in close agreement for areas sampled outside the exclusion fence eastward for approximately 2 miles.

Plutonium released to the environment is transported to man via air, soil, water micro-organisms, plants, and animals through a variety of physical and food chain processes. Resuspension of contaminated soil, and contaminated drinking water supplies are considered the major critical pathways for population exposure. Plant and animal uptakes are thought to be very small. Certain soil types and conditions may retard movement into water courses or even essentially stop them. The principal uncertanties associated with determination of such pathways to man are recognizing the very slow long-term mechanisms which may feed contaminants to many future generations. Small uptakes over a long period may be of significance. Details of these pathways vary with the nature of the facility, and the surrounding environment (4).

B. Location

The Rocky Flats Plant is divided into three distinct areas. At the center of the plant is the security area encompassed by the exclusion area, which in turn is surrounded by the public buffer zone.

The security area is enclosed by an eight foot fence with barbed wire outriggers and covers about 425 acres. The exclusion fence encompasses a total of 2,520 acres (about four square miles). Beyond the exclusion fence, additional lands have been acquired such that the new property line will establish a buffer zone from 1 to 1½ miles around the original facility as shown in Figure 7 (2).

The plant lies almost equally distant (roughly 8.5 miles) from Boulder, Golden, and Arvada, and about 16 miles from downtown Denver. The closest population centers shown in Figure 8 are Broomfield, Louisville, and Lafayette. There are, however, ranches, homes, commercial and recreational areas on unincorporated land nearer the plant. The Jefferson County Airport lies about 4 miles east-northeast. The airport and Jefferson County population densities around the plant are shown in Figure 9. Adjacent Boulder County land is zoned primarily agricultural. Boulder County population density data was not available. The Colorado State Planning Commission has forecasted continued rapid development of the Colorado front range within the area where Rocky Flats is located. The area is susceptable to winds, but because of them and the 6,000 foot elevation, it is relatively smog free with scienic views of both mountains and plains, which make it attractive for residential development. (8)

C. Criteria for Siting

Criteria for siting theRocky Flats Plant was based, in part on adequate power and water supplies, maximum and minimum distances from population centers, proximity to major rail and highway transportation routes,

(DISINTEGRATIONS PER MINUTE/GRAM OF DRY SOIL)

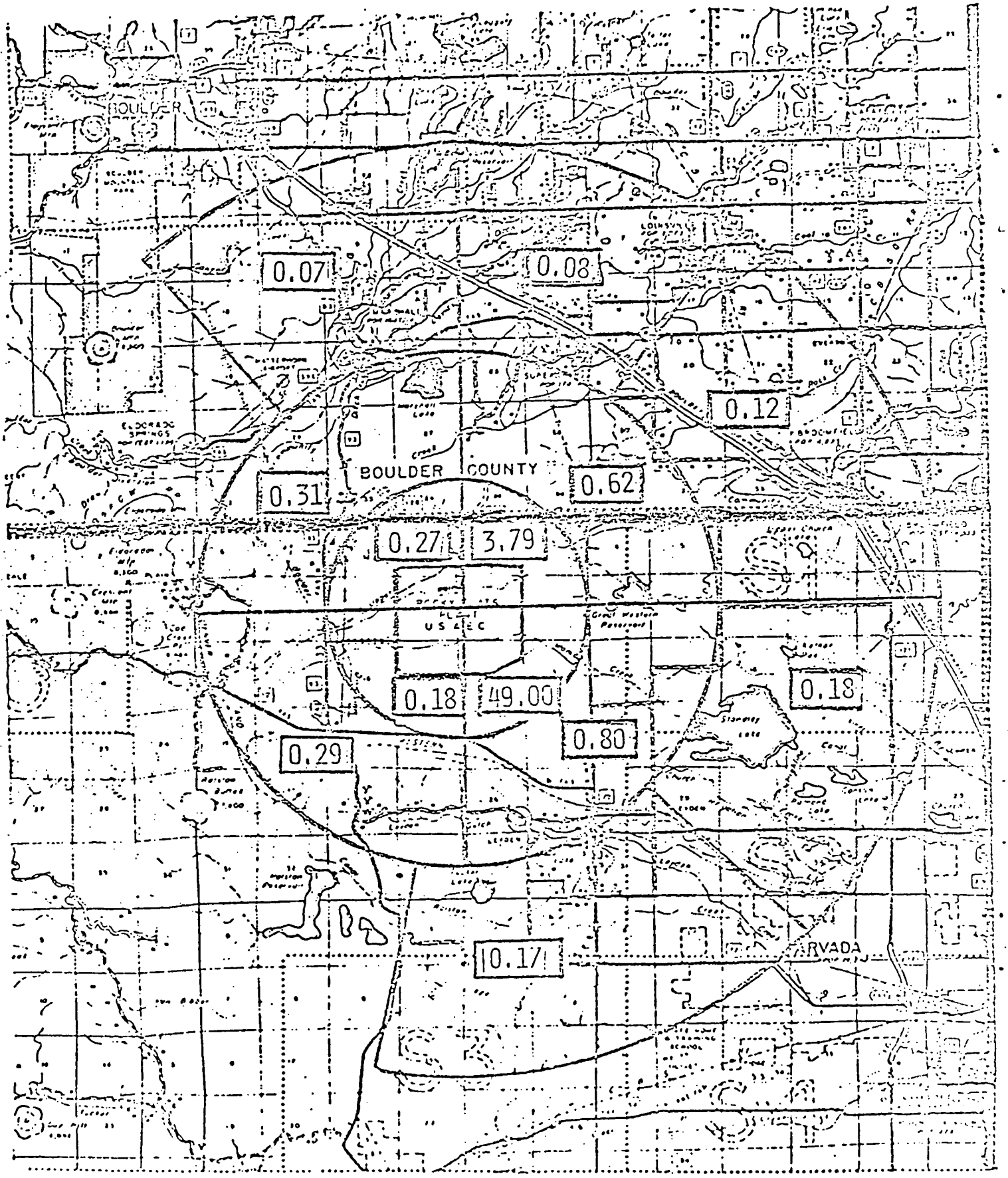

FIGURE 6: Disintegrations per minute/gram of Dry Soil.

SOURCE: Colorado Department of Health (1970-73 Averages)

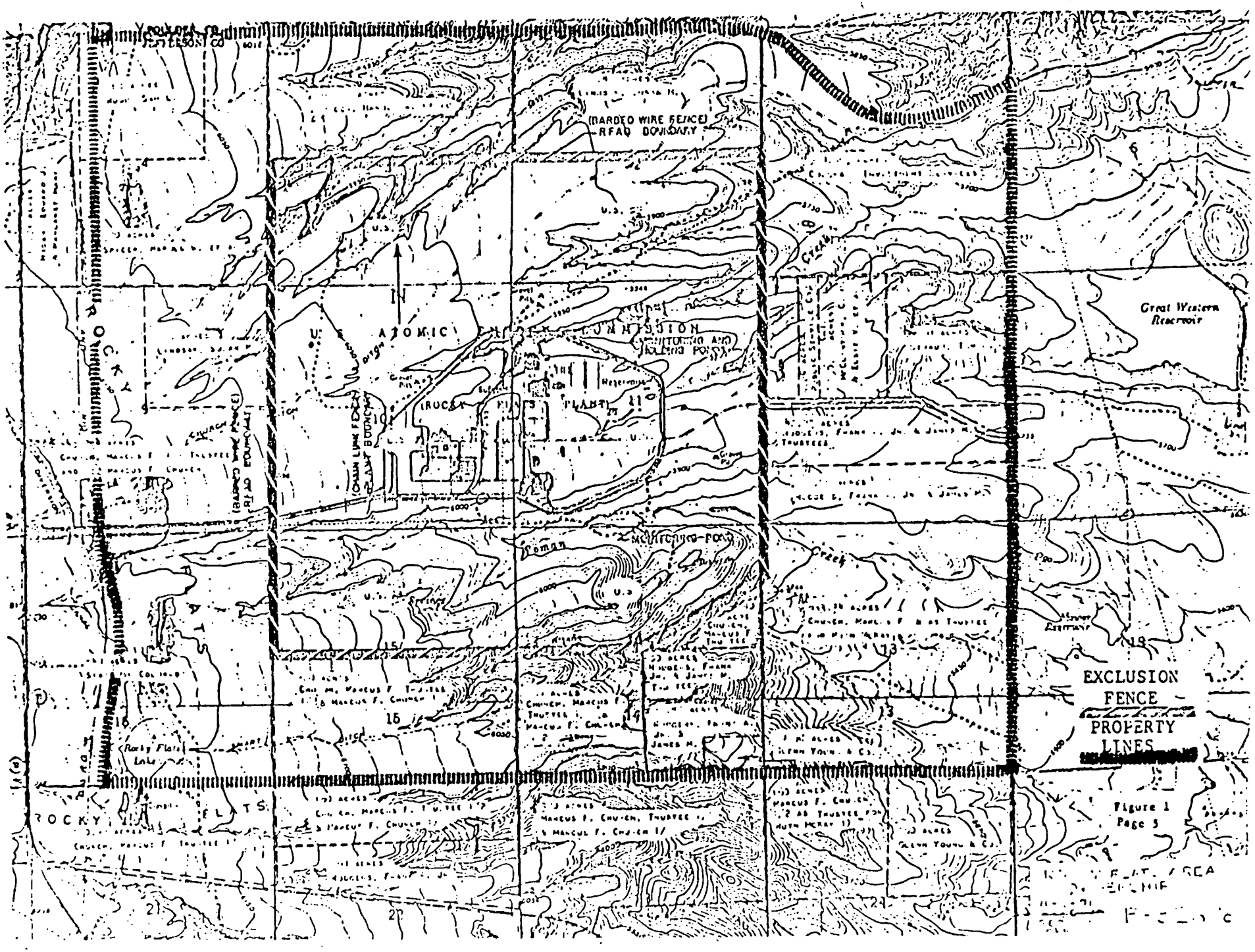

FIGURE 7. Approximate Exclusion Fence and Property Lines.

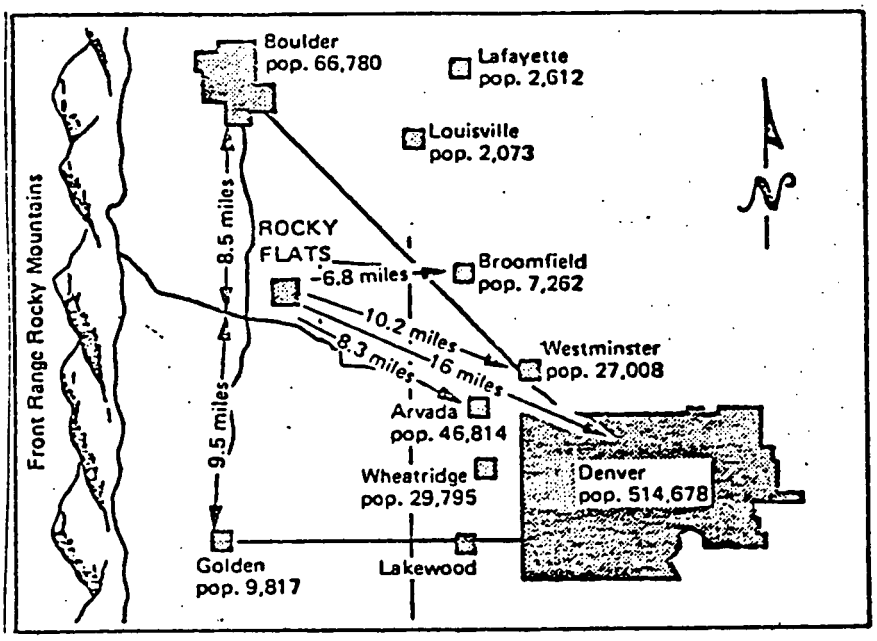

FIGURE 8

Incorporated Population Centers around Rocky Flats

SOURCE: Annual Report: Environmental Safeguard 1971
Dow Chemical Company, Rocky Flats Division
(RFP-ENV-71B)

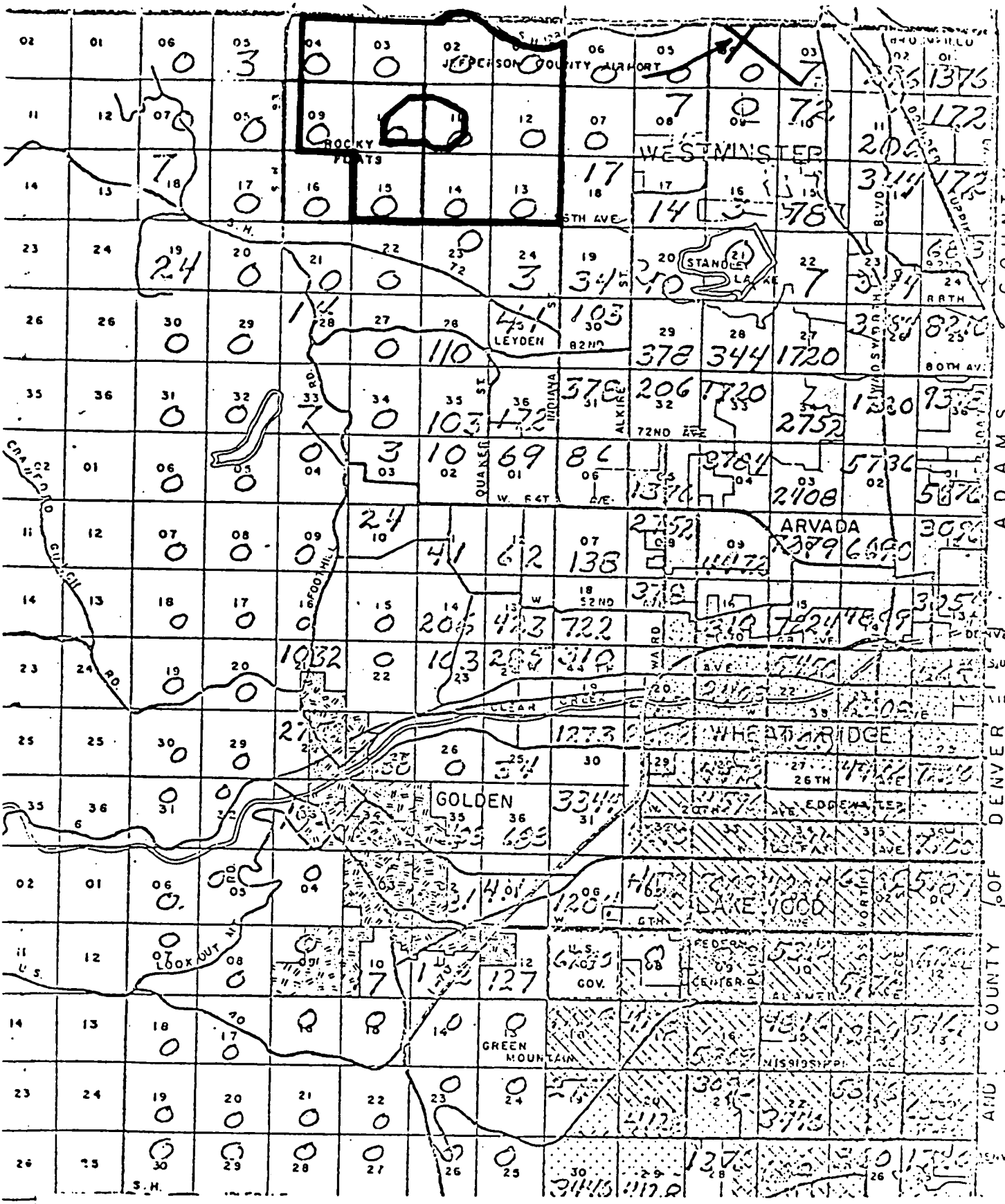

FIGURE 9: Population Density in Northern Jefferson County
(Persons per square mile)

SOURCE: Jefferson County Planning and Zoning Department, (1974 data).

and the availability of a major military airfield to provide transport to all parts of the country. No specific meteorology criteria was included except for the suggestion that it was desirable for the facility to be on the leeward side of the population center. The Rocky Flats site was selected from several sites under consideration in the Denver area (9). North locations were favored, based on the Denver windrose patterns (10).

D. Geology and Hydrology

The plant and surrounding area is located on an alluvial fan-shaped plain, of gravel and sand created by water flow out of Coal Creek Canyon. This sloped fan has an approximate radius of five miles and overlays a bedrock surface called "pediment", which in turn is underlain with from 25 to 80 feet of rock, sand, and gravel on a clay base. Beneath the gravel layer is a silty clay stone known as the Laramie Formation which extends 700 to 800 feet in depth. Ground water is found primarily in the lower part of the surface gravel layer and is the water source of numerous springs which emerge at the edge of the pediment south and southeast of the plant boundry. Drainage from these springs is collected, primarily in Walnut Creek with small but significant contributions to Woman Creek. Woman Creek as shown in Figure 10 empties into Standley Lake (Westminster's water supply) while Walnut Creek empties into Great Western Reservoir (Broomfield's water supply). The shallow water table varies in depth from 9 to 31 feet at the west exclusion fence and 10 to 36 feet at the east exclusion fence. Ground water in Laramie Formation is likely to travel east beyond the municipal surface water reservoirs, however, the clay layer essentially precludes communication between the Laramie Formation and surface water (1,2). The plant lies very close to the steep eastern slope of the Rocky Mountains and surface water in the area flows from west to the east and northeast.

There has been no evidence of faulting in the immediate area of the plant, and history has shown it seismically inactive. The nearest earthquake activity has centered around Adams City, Colorado about 17 miles away. The highest shock waves recorded in that area were in August and November 1967, and measured 5.3 and 5.8 on the Richter scale respectively. They are believed to have been the result of the Rocky Mountain Arsenal Deep Well Waste Injection Process. Since that practice has ceased, there has been no significant seismic activity (1,2).

E. Meteorology

Precipitation averages 15.04 inches primarily from heavy wet snows in early fall and spring. Maximum annual precipitation was 24.87 inches in 1969, with a minimum precipitation in 1954 of 7.76 inches (2).

Average daily temperatures (18 year) are: Mean 50°F, Maximum 77°F, Minimum -22°F. A record high of 100°F occurred on August 14, 1956, and a low of -26°F on January 12, 1963. Temperature gradiants are important in determining strength of vertical wind currents which lift and disperse pollutants.(2)

Wind conditions at Rocky Flats are quite variable, but predominantly from the west at velocities of 7 to 11 miles per hour on an annual average. Strong westerly winter winds range from 30 to 60 miles per hour. Record peak gusts have exceeded 100 miles per hour (2).

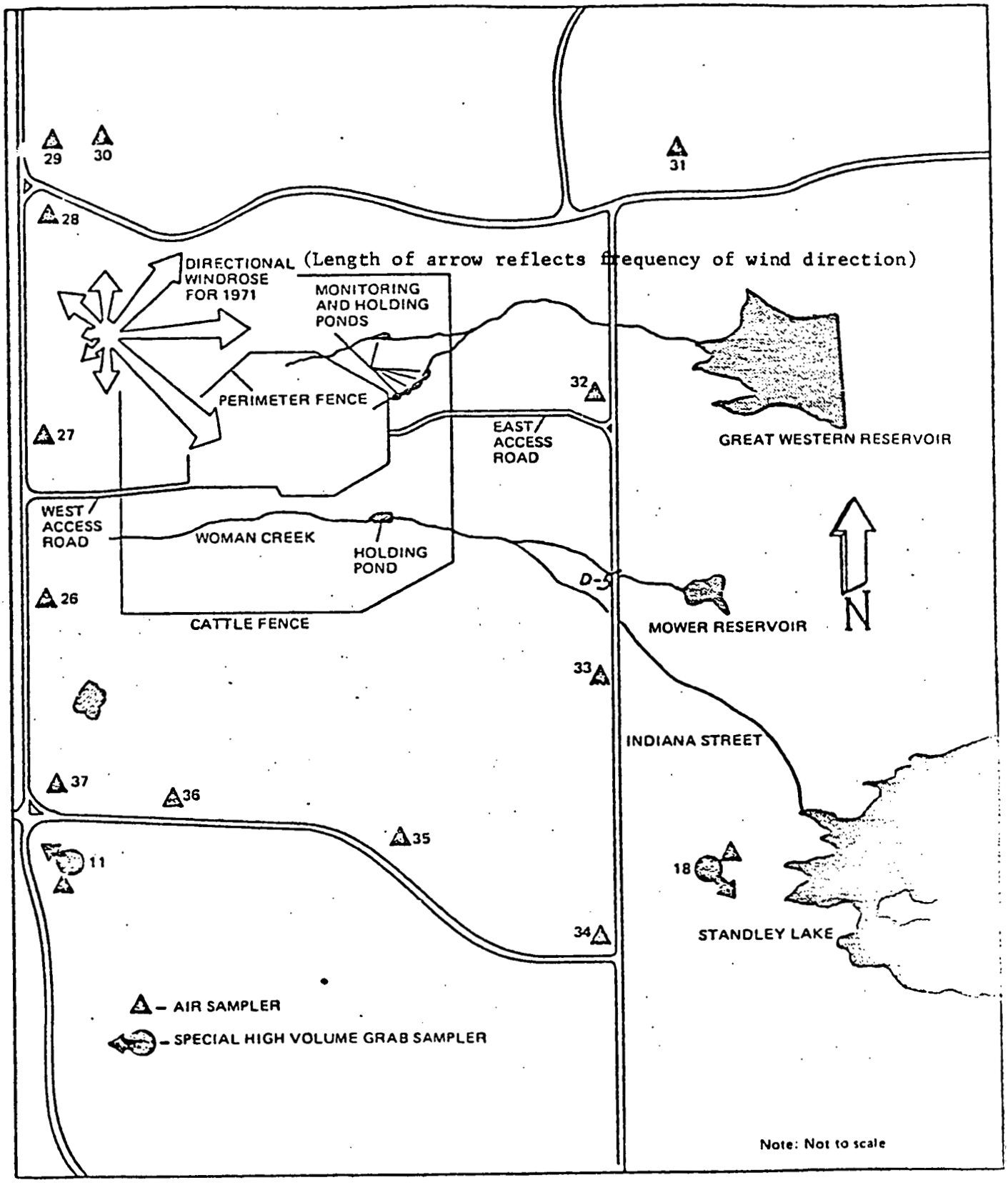

FIGURE 10

Map Showing Surface Drainage and part of Off-Site Air Sampling Network Maintained by Dow Chemical.

SOURCE: Annual Report: Environmental Safeguard 1971 Dow Chemical Company Rocky Flats Division (RFP-ENV-71B)

Based on a two-year period, 1972 and 1973, air flow patterns under stable, neutral, and unstable conditions have been characterized by Crow (11). During stable (calm air) conditions there is a distinct difference between air flow patterns out of the Denver Metropolitan area and the air flow from Rocky Flats as indicated in Figure 11. The ridge in the Federal Heights area between Denver and Rocky Flats directs most of the air flow from Rocky Flats to the northeast. There is, however, documented evidence of air flow from the plant to the Denver Metropolitan area. The two nearly separate air masses (with very little vertical mixing) converge in a broad area above the Platte River Valley which extends north between Brighton and Plattville, Colorado. Pollutants emitted near the ground under these conditions will flow downslope. Stable conditions are usually followed by periods of calm and in turn are followed by upslope air patterns (Figure 12) which are normally more divergent in return flow. Air pollutants aloft tend to remain aloft over cold air masses with minimal fallout under upslope and downslope stable conditions. Fallout which does take place, though minimal, will deposit primarily where the two air masses converge. Stable air flow conditions prevail roughly 36% of the time.

Neutral conditions present well mixed air flow, in a wide range of directions with slightly higher frequency to the northeast. Greater vertical dispersion decreases airborne pollutant concentrations at ground level. Neutral conditions persist roughly 53% of the time.

Unstable (high wind) conditions generally occur in the Rocky Flats area when air is moving toward the mountains with corresponding rapid vertical mixing. The air concentrations are diluted by rapid mixing and down wind dispersion. Wind speeds exceeding 30 miles per hour can cause resuspension and movement of soil particles several miles (with very light particles moving probably hundreds of miles), while the heaviest particles fallout within a few hundred feet.

Unstable conditions exist about 11% of the time. Wind speeds greater than 20 miles per hour occur roughly 6% of the time during unstable conditions.

Plume dispersion under neutral conditions, on the plant site has been studied by Meroney and Chaudhry (12). They point out that (1) wind patterns and plume dispersions follow the same low land pattern as does surface water drainage, (2) that a plume from the 250 foot stack shows no dispersion effects from the buildings but tends to bend northward as it crosses Woman Creek due to the Rocky Flats ridge formation, and (3) that the greatest effects from buildings and terrain are on effluent releases from the Manufacturing Building No. 881 during northwest winds. They conclude, however, that (1) buildings and terrain do not significantly distort plume behavior from that suggested in classical plume model studies, (2) that there does not appear to be any most meteorologically unfavorable condition with respect to plume path or dispersion, and (3) that it is unlikely (under neutral conditions) that gases released from building roof vents will deposit material beyond plant boundaries without leaving evidence of passage at ground level. They also advised that, (1) an array of air monitoring devices should be placed at 500 foot intervals or closer to effectively intercept plumes at

Indiana Street, and (2) that a computer model including topography, surface shear, deposition, entrainment and soil movement should be developed for the site to provide real time estimation of effluent movement beyond the initial calculated dispersion.

F. Ecology

Plant life at Rocky Flats is typical of the short grass prairie region. The rocky surfaces, poor seasonal moisture distribution, dry winds, and permeable gravel substrate preclude raising of agricultural crops on much of the buffer zone. Agriculturally zoned land in the surrounding area is used primarily for grazing and wheat farming.

The moist drainage areas harbor cattail, willow, ferns, algae, and over 200 other species of plant life. Plutonium uptake by algae has been shown in a variety of studies (3). Plutonium concentration factors* in the primary algae species at Rocky Flats (Green and Blue-green algae) have been determined by Colorado State University (13). Concentration factors for plutonium oxide, the most likely environmental form, ranged from 10,000 to 50,000 in field studies of the area ponds and streams.

Animal inhabitants are the typical rodents; squirrels, rabbits, coyote, and deer. Common ducks, small birds, pheasants, hawks and crows frequent the area. Amphibians and reptiles include salamanders, toads, frogs, turtles and a variety of snakes including the crotalus (rattlesnake) (1,2).

Plutonium levels in various tissues of pocket gophers and deermice have been found to range from less than 1 to 1619 disintegrations per gram of tissue. The highest level is found in the kidneys of deermice (14).

II. WASTE HANDLING

The Rocky Flats Plant, in addition to handling the normal solid and liquid waste, filters all air leaving processing buildings to reduce the amount of airborne contaminants released from the plant site. The northern half of the plant is involved in processing plutonium and in general waste treatment, while the southern half houses uranium and beryllium operations.

Liquid wastes are generated in three types: (1) sanitary waste - which consists of sewage, steam condensates and cooling waters, all being low in radioactive and chemical pollutants, (2) industrial waste - which consists primarily of sodium hydroxide and nitric acid solutions with recoverable amounts of radioactivity, and (3) plutonium contaminated oils and solvents. Liquid wastes from (2) and (3) above are treated by caustic precipitation, and the residual solidified in cement for shipment as solid waste. Since December 1973, liquids from (1) above, after having been analyzed to assure that drinking

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* The concentration factor is expressed as (pCi/gm of Algae per pCi/gm of Water).

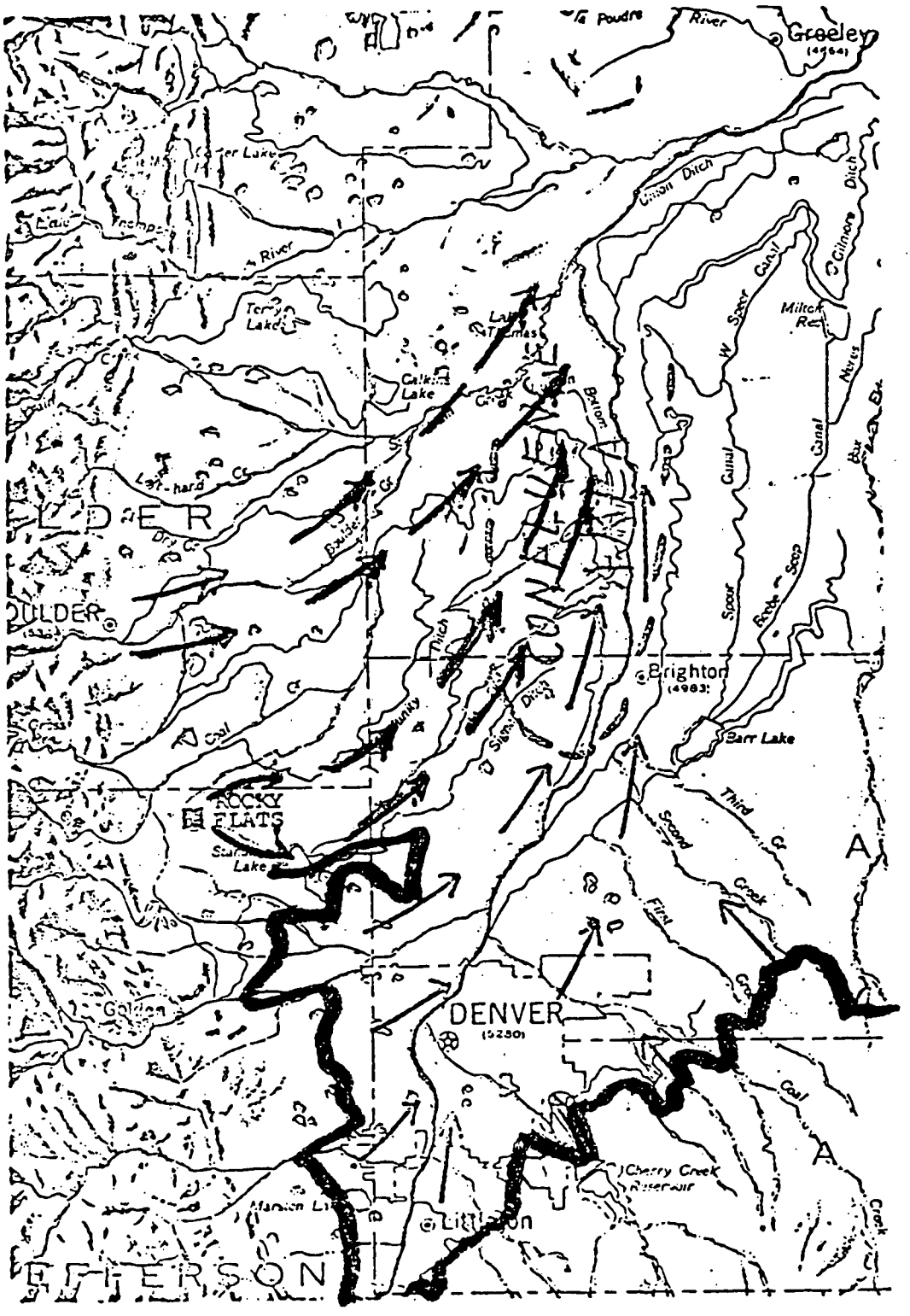

Figure 11: Characteristic downslope airflow during STABLE conditions in the geographic region from the south edge of the Denver metropolitan area northward. (11)

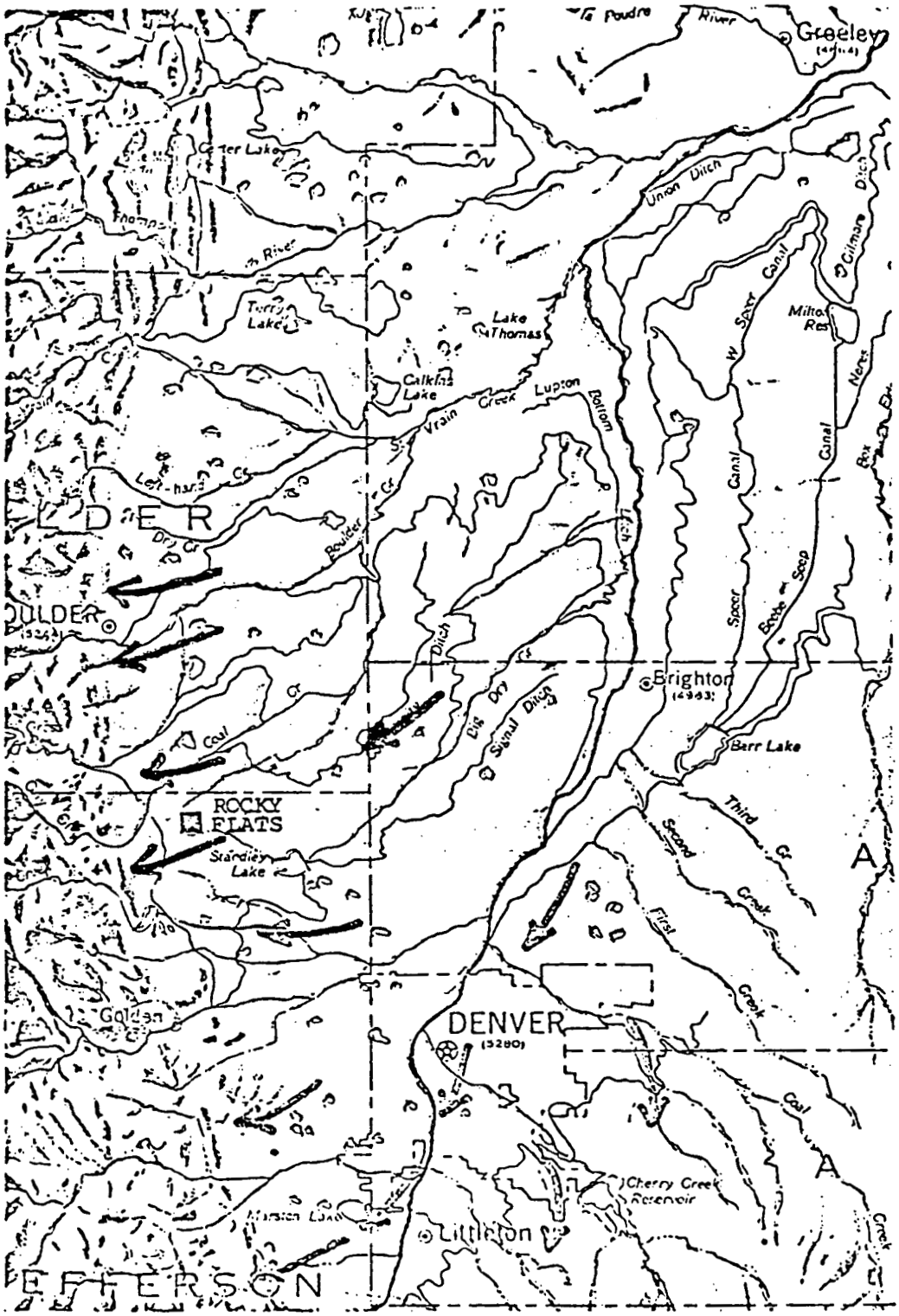

Figure 12: Characteristic upslope flow patterns which occur immediately following the reversal of airflow on "turn-around" type days. (11)

water standards are not exceeded, are released from the plant through ponds B-1, B-3, and B-4. These ponds, as shown in Figure 13, empty into South Walnut Creek and subsequently, into Great Western Reservoir (Broomfield water supply). Liquids from (2) above, known to be high in chemical pollutants including nitrates are held in storage ponds B-2 and A-2. Previously, these effluents were all released into Walnut Creek. Plutonium contaminated sediment has been found in Great Western Reservoir with a maximum concentration approximating 40 times the baseline concentration of 0.10 picocuries per gram (dry weight) found in other uninvolved front range reservoirs (15). A total of 87.5 millocuries* of Plutonium has been released to Walnut Creek from 1953 through 1974 (10). The Broomfield water has a small fraction of one percent of the present permissible standard for public consumption.

Seepage and overflow under high wind conditions from the solar evaporation ponds, has resulted in saturation of the surrounding soil. Heavy rains and rapid snow melt subsequently transfer nitrates from the saturated soil into Walnut Creek resulting in concentrations occasionally in excess of the drinking water standard of 45 parts per million (ppm)(15). The monthly average concentration exceeded this standard in April, 1970. Associated with a rapid snow melt, a peak concentration was observed at 350 ppm on February 20, 1974 in Walnut Creek at Indiana Street. Though Walnut Creek concentrations are occasionally high, the standard has never been exceeded in the Broomfield water supply which reached a maximum of 6.4 ppm in April 1970, and has had an overall average of 1.2 ppm nitrates (6).

Solid waste consists of contaminated glove-box replacement parts, sludges, treated residues, paper wastes, and processed ash from incinerated solids. All wastes are reportedly processed if recoverable amounts of plutonium are present. Solid wastes being barreled and shipped from the plant reached the highest rate of 2,000 - 55 gallon drums per month in 1972. The present rate is approximately 1,000 drums per month. Plutonium contaminated equipment is also considered solid waste, and decontaminated prior to shipment for disposal. A variety of radioactive and non-radioactive substances have been buried on-site in the past. Descriptions and locations are given in Figure 14.

Oils and solvents until 1968 were stored outdoors. Leakage from barrels of contaminated oils and solvents with ground contamination and subsequent resuspension of the contaminated soils has been of primary concern to the Colorado Department of Health. The point of the spill has been covered with an asphalt pad, (considered a temporary control) however, some highly contaminated spots remain uncovered off the southeast edge of the pad (see Figure 15).

Air surveillance networks provided by the Rocky Flats Plant, the Health and Safety Laboratory (AEC) and the State Health Department indicate elevated soil concentrations correspond with elevated air concentrations. State

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* 1 millicure = $\frac{1}{1000}$ of a curie or 1000 microcuries

AQUEOUS WASTE SYSTEM – ROCKY FLATS PLANT
(MARCH, 1974)

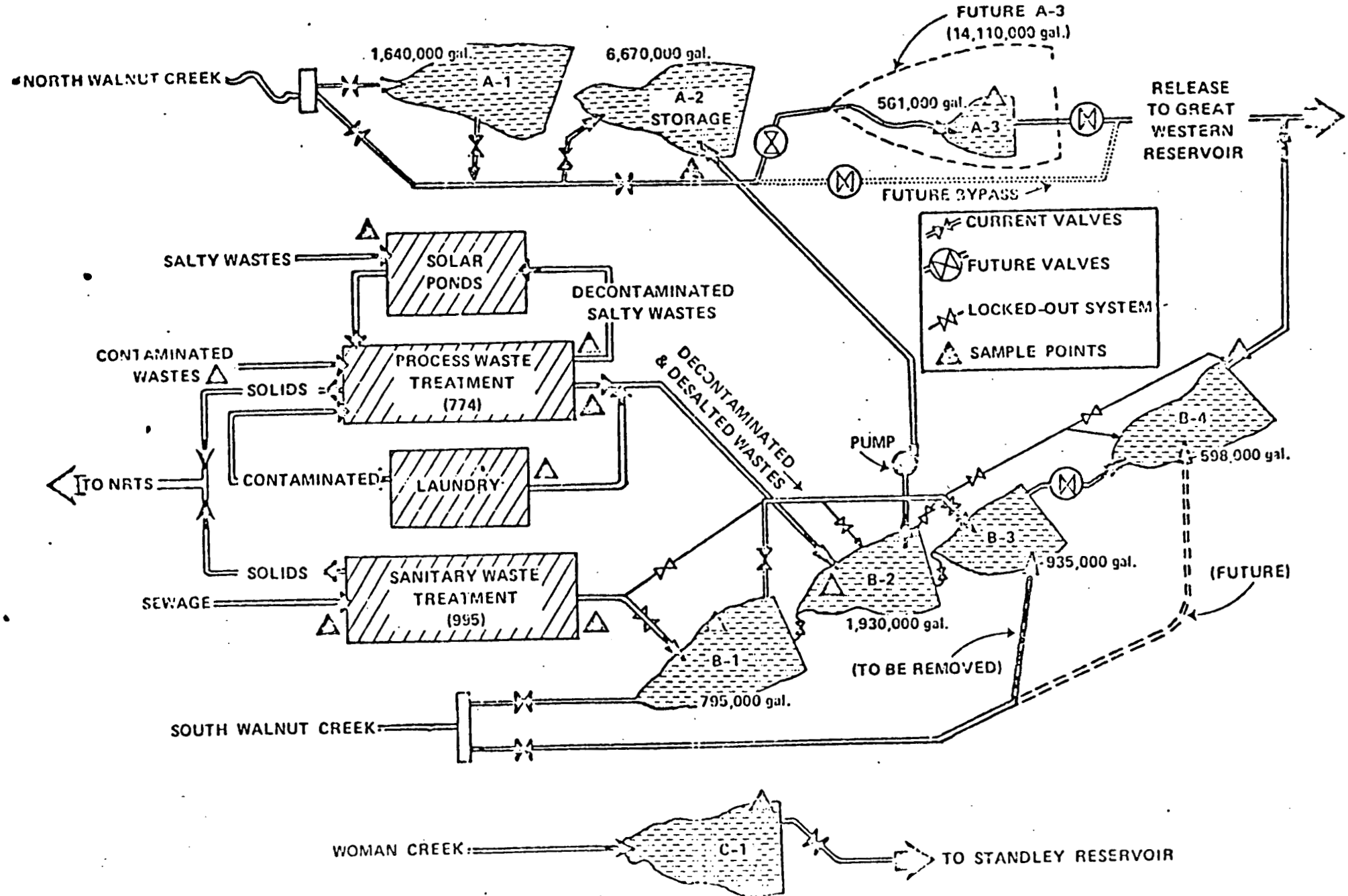
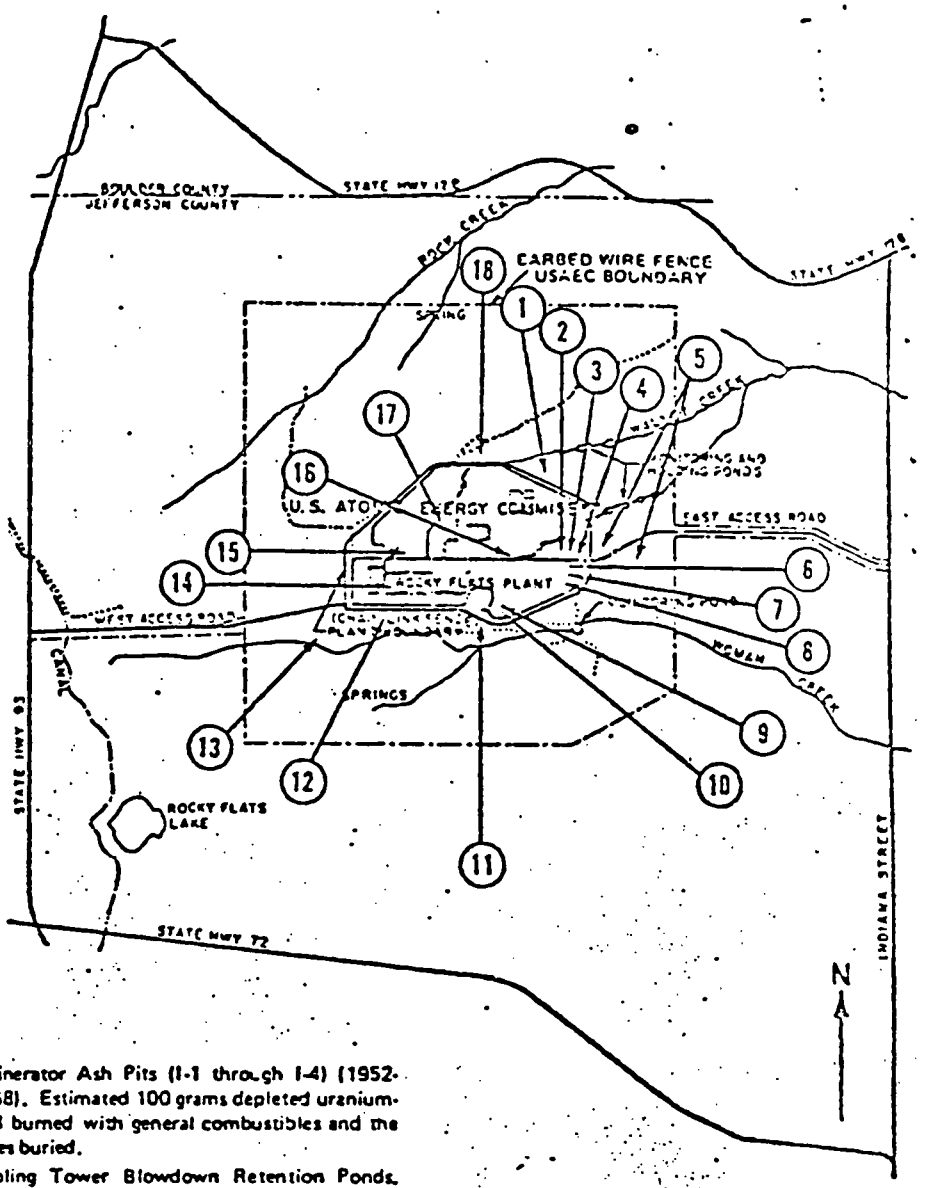


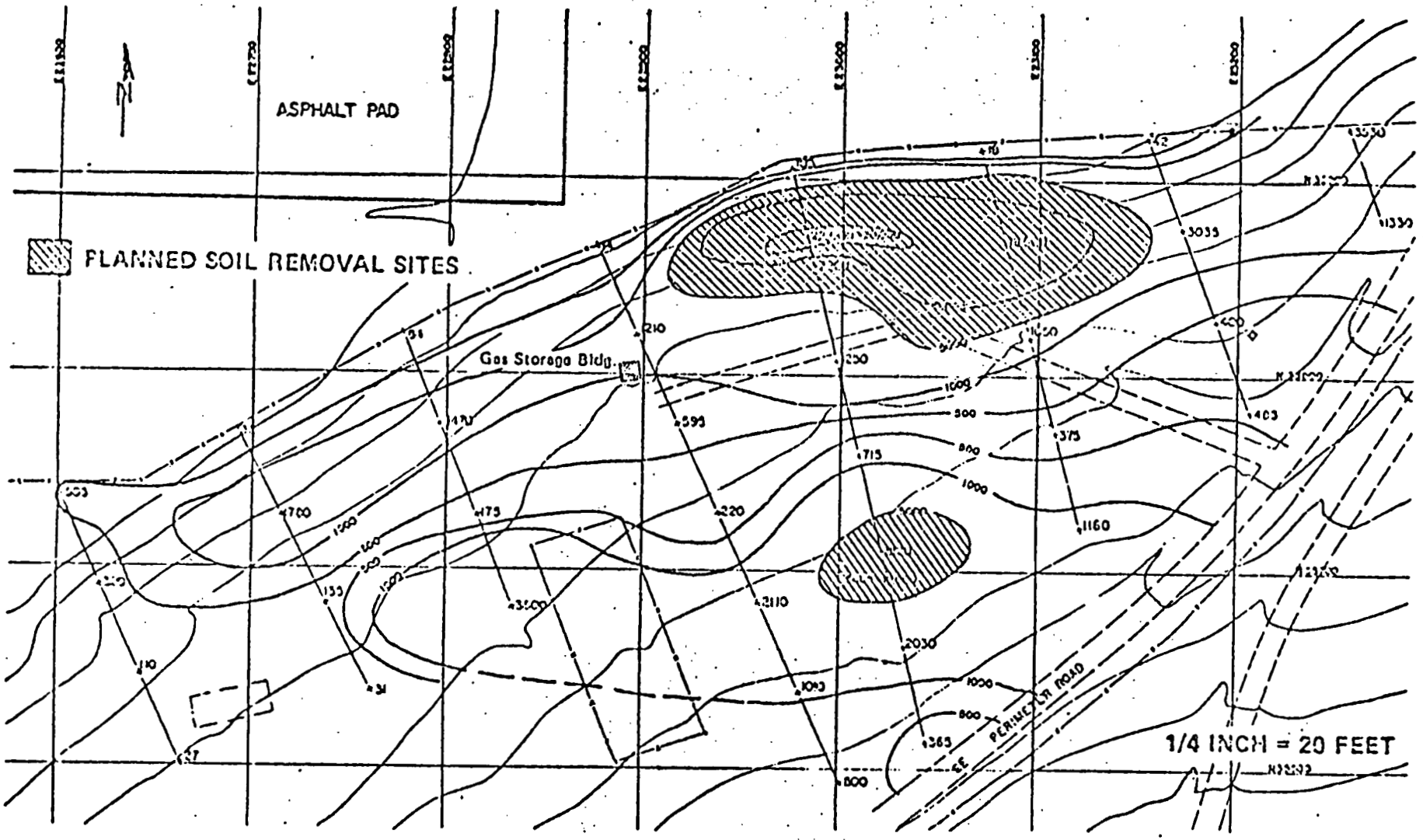
FIGURE 13: Aqueous Waste System - Rocky Flats Plant
SOURCE: Earl Bean, Assistant Manager, U.S. AEC Rocky Flats Operation (1974)



1. Nitrate Field. Elevated nitrate ion concentrations due to seepage from the solar ponds.
2. Oil Burning Pit No. 2 (1957, 1961-1965). Buried residue from burning contents of 1093 drums uranium-contaminated oil.
3. Mound Area (1954-1958). Storage area for 1405 drums oil and sludge contaminated with depleted uranium-238 and enriched uranium. All materials removed for offsite disposal in May, 1970.
4. Trench T-1 (1954-1962). Estimated 25,000 Kg depleted uranium-238 chips buried in drums under 2 feet of fill dirt.
5. Trenches T-2 through T-8 (1954-1958). Disposal site for estimated 100,000 Kg uranium-plutonium contaminated sanitary sewage sludge. Also, in trench T-4, uranium-plutonium contaminated asphalt planking. Estimated total alpha radioactivity: 100-150 mCi.
6. Oil Drum Storage Field ("Asphalt Pad") (1958-1967). 3572 drums of plutonium-contaminated oil and 1254 drums of uranium-contaminated oil stored until removal for disposal completed in June, 1968. Leakage from the drums deposited an estimated 85 grams (~37 curies) of plutonium in the soil. Soil surveys indicate approximately 16 grams of plutonium migrated eastward from the pad area prior to asphalting. November 1969, a 146,000 sq. ft. area covered with an asphalt cap to contain the plutonium until a safe disposal method can be developed.
7. Contaminated Soil. Area contaminated [redacted] from "Oil Storage Drum Field". An estimated 7 grams (~3 curies) of plutonium spread over an area of 124,000 sq. ft. within the plant security fence.
8. Lithium Destruction Area (1956-1971). Buried the residue from the destruction of 400-500 pounds metallic lithium and small quantities of sodium, calcium, magnesium and solvent compounds.
9. Contaminated Soil Burial (1972). Buried 60 cubic yards of plutonium contaminated soil. Estimated alpha radioactivity: Less than 5 mCi.
10. Contaminated Asphalt Disposal (1969). Buried 320 tons of plutonium contaminated asphalt and soil from May, 1969 fire. Estimated: Less than 1 mCi in 250 cubic yards of material.
11. Oil Disposal Pit (1952). Buried contents of 30-50 drums of uncontaminated oil sludge.
12. Original Sanitary Landfill (1952-1968). Estimated 20 Kg depleted uranium-238 ash buried with normal plant waste and small quantities of surplus chemicals.
13. Incinerator Ash Pits (I-1 through I-4) (1952-1968). Estimated 100 grams depleted uranium-238 burned with general combustibles and the ashes buried.
14. Cooling Tower Blowdown Retention Ponds. The corrosion inhibitor, hexavalent chromium, is present. Some small quantity of lithium was also destroyed in the Eastern-most ponds. Ponds are covered with fill.
15. Oil Burning Pit No. 1 (August 1956). Buried the residue from burning ten drums of oil contaminated with depleted uranium-238.
16. Pallet Destruction Area (1968). No detectable radioactive or chemical contamination observed.
17. Scrap Metal Disposal (1958). Scrap metal from original construction. No detectable radioactive or chemical contamination.
18. Sanitary Landfill (Started in 1968). Estimated 9,000,000 pounds uncontaminated waste buried annually. From August, 1968 to February, 1970 approximately 1000 Kg sanitary sewage sludge (containing 1 to 1.5 mCi alpha radioactivity) buried in landfill. Recent surveys indicate very low levels of plutonium, tritium and strontium-90 contaminated waste in the landfill.

FIGURE 14: Rocky Flats Contaminated Soil and Waste Burial Sites.

SOURCE: U. S. AEC February, 1974



Plutonium Concentrations (d/m/g) Determined by Radiochemical Analysis of Soil Samples Collected in March, 1974.

FIGURE 15: Contaminated areas Southeast of the Asphalt Pad which was provided for temporary control of Plutonium contamination from the oil spill.
SOURCE: Earl Bean, Asst. Manager, U.S. AEC Rocky Flats Operation, February 1975.

Health Department records show the most reasonable approximation of an air concentration half-life to be 2.7 years, using a 9.6 year half-time for world-wide plutonium fallout. A resuspension term based on the annual average air concentration of plutonium, associated with Department air sampling stations D-3, D-4, and D-5, range from 5×10^{-10} per meter*. Colorado Department of Health Air Sampling Stations are shown on Figure 16.

Station D-3, located on highly contaminated soil (10[redacted] uCi/m^2) shows a large variation in air concentrations. The maximum concentration for one 24 hour sample was 0.4 picocurie** per cubic meter of air (pCi/m^3), yet overall concentrations have been low enough to give a maximum annual concentration of 0.01 pCi/m^3 and a 4 year average of 0.006 pCi/m^3 which is approximately 100 times the world-wide fallout level. Sampling locations closer to private agricultural and residential property such as D-5 at Indiana Street (0.1 uCi/m^2) show average 4-year air concentrations, approximating two times that due to world-wide plutonium fallout.

Factors which affect resuspension include source configuration, meteorological conditions, mechanical disturbances, plutonium and soil particle size, soil structure and moisture content, vegetative and overlaying cover, chemical form of the contaminant, air flow modification and induced turbulance, and the age of the contaminating deposit. Based on the data acquired, subdivided land with soil concentrations approximating the Colorado plutonium-in-soil standard (17) will not experience air concentrations significantly different from those observed due to world-wide fallout.

Air effluents from plant operations are filtered through High Efficiency Particulate Air (HEPA) filters to control contaminant release. The efficiency of these filters is rated at 99.97% for a particle size of 0.3 micron. It is more efficient for larger sizes and theoretically more efficient for particles smaller than 0.3 micron. Air effluent releases which may contain hazardous particulates originate from chemical processing, manufacturing, fabrication, assembly, and industrial waste treatment buildings. All discharge stacks have at least one bank of HEPA filters; plutonium manufacturing and processing buildings have three to four filter banks or stages. Each stage has the capability to reduce particulate concentrations by a factor of about 10,000. The plant monitors 29 effluent stacks for plutonium, 25 for beryllium, 6 for uranium and 6 for tritium. This represents total air effluent monitoring of these contaminants. The total amount of plutonium released through the air filter systems to the environment from 1953 through 1974 is estimated at 25 mCi, and Uranium-235 and 238 respectively at 4.1 and 2.9 mCi. Releases of Beryllium in the same time period are estimated at less than 47 grams. The tritium incident in the Spring of 1973 released somewhere between 500 and 2000 Curies. Subsequent monitoring from October 1973 through December 1974 indicates release of an additional 13.4 Curies (10).

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* Resuspension factors are unit-less; derived through multiplying the air-concentration (uCi/m^3) by the inverse of the soil concentration (m^2/uCi).

** 1 pCi (one picocurie) = $\frac{1}{1{,}000{,}000 \text{ uCi}}$ or 1,000,000 pCi = 1 uCi

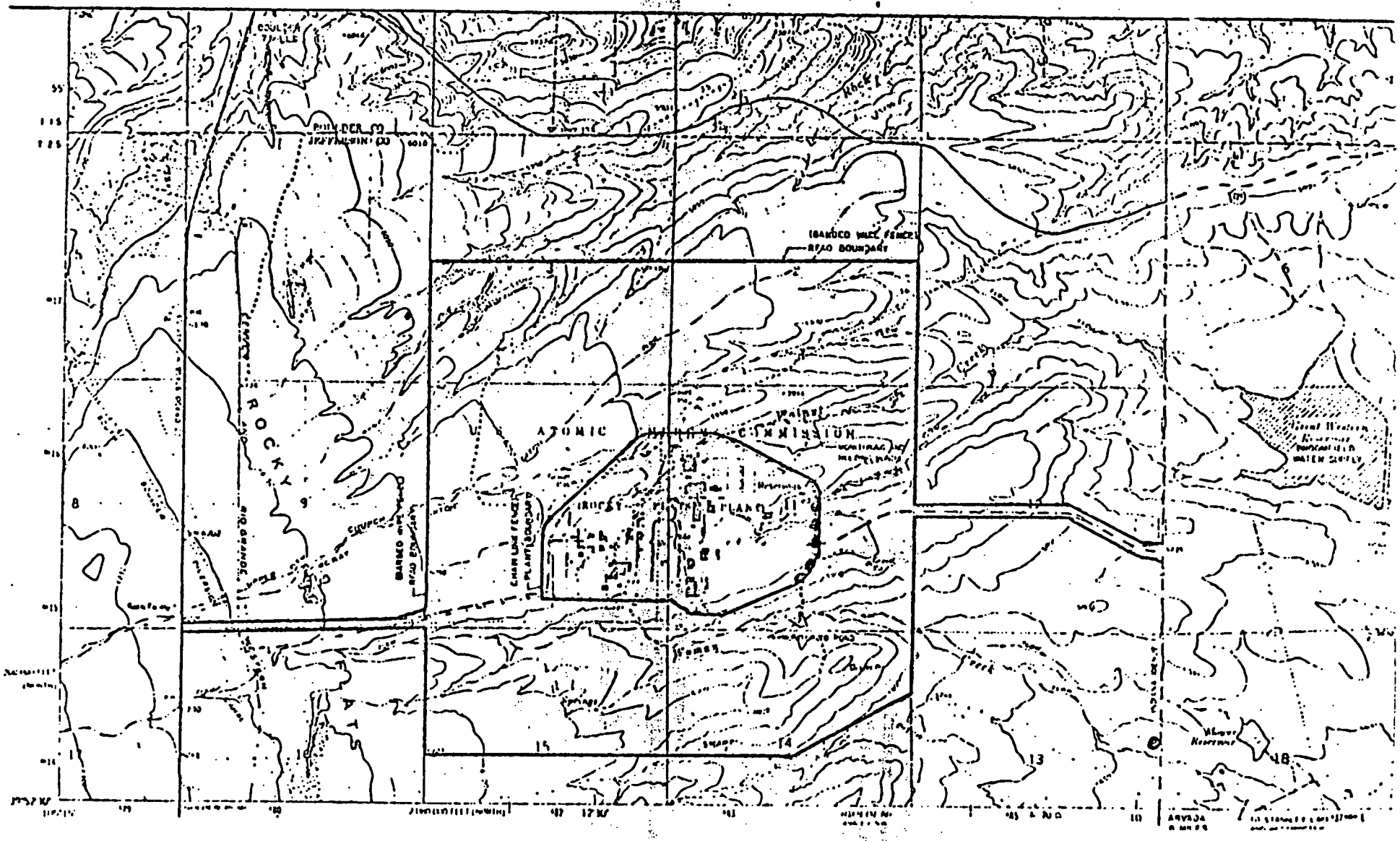

FIGURE 16: Colorado Department of Health, Air Sampling Stations.

III. SECURITY AND SAFEGUARDS

An eight foot high fence with barbed wire outriggers is provided as a deterrent to unlawful entry of the security area. Each major facility on the plant site is also enclosed in its own security fence. There are armed guard posts and patrol vehicles throughout the plant area. Routine exercises are provided to test response to various emergency situations. Additionally, arrangements have been made with law enforcement agencies in the surrounding communities for assistance if needed.

All personnel entering the plant site are required to wear identification badges which include a radiation monitoring device, identification of the individual, his clearance, and the areas to which he may be admitted. Persons not having official security clearance are required to have an authorized escort.

Recent safeguard innovations include the installation of radiation monitors at facility access points to detect unauthorized possession of fissile materials. This acts as the backup system to the record which accompanies each significant amount of fissile material and documents its history.

An armed guard with continuous radio communications escorts each shipment of strategic material to and from the plant. The AEC has appraised the State Patrol of shipment requirements and provided other pertinent information necessary to the Patrol's function. Empty fissile material containers shipped by commercial or contract carriers are not escorted. Restrictions have, however, been placed on the carrier to preclude unauthorized access. The air space over the plant site has not been "closed to air traffic.

IV. NOTEABLE EVENTS

Environmental contamination accidents and incidents involving plant buildings and/or the plant site and the surrounding area are listed chronologically below:

September 1955 - Glove-box fire resulting in the release of 2.3 micrograms of plutonium.

September 11, 1957 - A fire involving 22 kilograms of plutonium occurred in a glove-box. Fans continued to run for 15 minutes after the fire was discovered. Air filter plenums were burned out and off-site release was estimated at 1 mCi.

October 15, 1965 - Fire involving 20-30 grams of plutonium chips and oil contaminated the inside of a building. No off-site contamination was detected.

1958-67 - Oil containing plutonium was stored in drums in an area southwest of the east gate. Leaking was first noted in 1964. This situation resulted in the release of 3-5 curies of plutonium to the off-site environment.

May 11, 1969 - Fire in Building 776-777 resulted in a 40-50 million dollar loss. Some plutonium escaped from the buildings, but no significant amount was detected off-site.

October 1969 - Accidental nitrate release into Walnut Creek. Material was supposed to have been pumped to solar evaporation ponds.

September 14, 1970 - Colorado Department of Health was notified that 2,000 gallons of sulfuric acid was lost on the surface of the ground at the steam plant. A faulty gasket had been installed. A week later an elevated sulfate level was observed in Walnut Creek at Indiana Street.

May 23, 1971 - On-site leakage was detected by Dow Chemical from shipping crates to be sent to the National Reactor Testing Station. Colorado Department of Health was notified and visited the area. New containers have been developed.

Fall and Winter 1972 - Rise in plutonium levels was observed in Walnut Creek at Indiana Street and CDH Air Sampling Stations D-1 and D-2. This was probably due to earth moving or work on liquid waste disposal system. Levels returned to normal by May 1973. Peak water concentration observed in December 1972 was 163 picocuries per liter.

June 1972 - Installation of oversized pump in piping from one building to the industrial waste treatment facility caused "high level" wastes to be backed up in a toilet (cross connection between the industrial waste piping and sanitary sewerage). Cross connection has been eliminated.

February 14 and March 21, 1973 - Hearing on Colorado plutonium-in-soil standard. This standard became effective May 1, 1973.

Spring 1973 - Nitrates continue to be a problem in the North Walnut Creek drainage, due to leakage from solar evaporation ponds.

Spring and Summer 1973 - Lawrence Livermore Laboratory shipped plutonium scrap contaminated with tritium, resulting in release of tritium to Rocky Flats environs. Plutonium processing released the tritium as a gas which in turn combined with oxygen in the air, or with water, to form tritiated water. The tritiated water was detected in Walnut Creek at its highest level (3,000,000 pCi/L) in May 1973. Urine sample analyses from Broomfield residents ranged from 1500 pCi/L to 8100 pCi/L, while the water supply averaged 10,000 pCi/L. Normal background levels are 1000 - 1200 pCi/L.

February 20, 1974 - The maximum nitrate level observed by the Colorado Department of Health in Walnut Creek at Indiana was 350 ppm during a period of rapid snow melt and high run-off. No effect was noted in the Broomfield water supply.

April 1-2, 1974 - Release of Plutonium from Building 707 due to work on air filter plenums. On-site stack sampling by Dow Chemical indicated concentration roughly 100 times normal.

V. CONTINGENCY PLANS

Off-Site

In 1970, a Rocky Flats Plant off-site contingency plan (18), which is a part of the State's overall emergency plan, was formulated. It was prepared under the direction of the State Department of Military Affairs, Division of Disaster Emergency Services with the cooperation of the State Health Department and the assistance of the AEC and other local governments and quasi-municipal groups which had a specific interest and responsibility. This plan is the basis of the plans for Boulder County, Jefferson County and the City and County of Denver, and it has never been tested.

The Division of Disaster Emergency Services and the State Health Department mutually agreed in early 1974 that the State plan for the Rocky Flats Plant was in need of revision and updating. A draft plan (19) for nuclear facilities (including the Fort St. Vrain Nuclear Power Generating Station) was prepared and has been distributed for review and comment.

The 1974 draft specifies that the Colorado Department of Health is the principal agency to be notified, with notification to the Colorado Division of Emergency Services after normal working hours. It calls for assistance of the State Patrol in their areas of jurisdiction, and County Sheriffs' Offices and Health Departments are to be notified of appropriate action to be taken in their areas. (The 1970 plan does not involve the state patrol or Boulder County officials in notification procedures and has never been tested.)

In conjunction with the plan the Department of Health has published guides for police departments, fire departments and hospitals in the event of a radiological emergency.

A medical response plan (20) was developed by Colorado General Hospital to provide medical services to radiation accident victims including persons from the Rocky Flats Plant and its environs. This plan was prepared to document the hospital's capabilities, however, no formal agreement was made between any major hospital in the Denver Metropolitan area and the Rocky Flats facility.

The 1974 draft, though very comprehensive at its present stage of development lacks the necessary awareness level of government agencies and medical institutions, which must actually respond to an emergency.

On-site

On-site contingency plans are incorporated into each of the individual building rules. They contain instructions and information pertaining to emergency call lists, building safety committees, alarm descriptions, shelter areas and evacuation routes.

The Rocky Flats Plant Emergency Manual (21), provides brief emergency instructions regarding action to be taken for various emergencies and includes a list of references where the employee can obtain more detailed information. Topics covered in the manual include communications, fires and explosions, on-site and off-site releases, criticality, mass casualties, sabotage, utilities interruptions, civil disturbances and civil defense.

Plan evacuation procedures and routes are included in the Emergency Disaster Mobilization Plans. The 1970 State of Colorado Plan is included in this plan.

A full-time fire department has existed since the operation of the plant began. Fire brigades have been formed for each building and respond immediately to emergency situations. Many of the guards are also trained in the special precautions necessary to fire fighting under the circumstances involved at the plant site. Outside assistance from the various fire districts in the surrounding communities has not been solicited due to the nature of the plant operations and the liabilities involved.

The plant maintains a 5-bed clinic and is capable of performing minor surgery at the plant site. Decontamination facilities exist at each of the manufacturing, fabrication and processing buildings and at the medical building.

Additional emergency assistance is available through various agency responce plans and teams (22). In cooperation with other participating agencies the Energy Research and Development Administration (ERDA), formerly the AEC, coordinates an Interagency Radiological Assistance Plan (IRAP). ERDA and the Department of Defense (DOD) have established a Joint Nuclear Accident Coordinating Center (JNACC) to handle nuclear weapons related accidents. The National Environmental Research Center (NERC) is available for environmental surveillance.

VI. FACILITY AND SITE IMPROVEMENTS

Following the May 1969 fire, a survey of the major production facilities and utilities was conducted by the Factory Insurance Association at the Rocky Flats Plant. This survey was very comprehensive from the standpoint of capitol loss fire protection and the report included 105 recommendations. As of January 3, 1975, 94 of these recommendations have implemented, 5 have been exempted by the General Manager of the AEC, 2 have

work pending and 4 are in progress. A resurvey was conducted in October 1974 by the Factory Insurance Association. Most of the recommendations outlined in the earlier report had been accomplished resulting in a well protected plant with good loss prevention programs. New buildings have been constructed utilizing superior protection and prevention criteria. The resurvey report contains 35 recommendations with some repeats from the 1969 survey. All recommendations regarding the 1969 fire cause-effect relationships have been implemented. The Factory Insurance Association called attention to the continuing need for effective management action to preclude the mitigation of the excellent fire protection now provided.

To preclude a recurrence of the 1969 fire and the unnecessary release of radioactive material to the plant environs, the following has been accomplished:

1) Large reduction of combustible neutron shielding on the glovebox lines.

2) Inerting of production line gloveboxes and plutonium storage vaults with greater than 95% nitrogen gas.

3) Compartmentalization of production areas.

4) Installation of fire doors, breaks, and dampers in the glovebox lines.

5) Plutonium chips are collected and briquetted or reduced to an oxide prior to each shift going off duty.

6) Installation of fail-safe fire detection and suppression systems in vulnerable areas; water now approved and available for fire-fighting fissile material fires under certain conditions; automatic sprinkler systems installed in all production areas and routinely tested.

7) Removal of combustibles from interior of glovebox lines.

8) Reduction of fissile material in the production lines.

9) Multiple water source supply lines provided to production buildings.

10) Installation of fire detection and suppression systems in air effluent filter plenums, and the installation of additional filter (HEPA) banks or stages servicing the production and industrial waste treatment facilities.

11) Provision of water retention dams in each building work area to contain contaminated water, should fire suppression equipment be activated.

12) Buildings 771 and 774 have been remodeled to provide adequate Health and Safety measures.

Additionally, a variety of measures have been taken to reduce and/or compensate for past environmental contamination,

1) The Sanitary Sewage and Industrial Waste systems have been completely separated. No industrial waste has been released to Walnut Creek since December 1973. Present plans call for complete recycle of all liquid wastes, including the sanitary wastes, by December 1976, if funding permits.

2) The solar evaporation ponds have been redesigned and sealed to prevent further release of high chemical content waters. A series of field drains have been provided to collect and return to the solar evaporation ponds any water contaminating surface acquifers.

3) McKay and Upper Church Ditches have been rerouted so as not to influence the storage ponds located on North Walnut Creek.

4) Reconstruction of the liquid effluent storage ponds on North and South Walnut Creek with intensification of monitoring, surveillance and analyses prior to decision for release or storage.

5) Redesign and protection of the sanitary landfill to divert surface water from the site.

6) Provision of package waste storage facilities precluding storage outside.

7) Provision of a 1 to 1½ mile wide buffer zone around the plant site (exclusion fence). This acquisition prevents subdivision development on lands grossly in excess of the State plutonium-in-soil standard.

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PRELIMINARY REPORT OF THE LEGAL SUBCOMMITTEE OF THE WIRTH/LAMM ROCKY FLATS TASK FORCE

I. CONTRACT PROVISIONS

The following is an analysis and comparison between the existing contract between the AEC (now ERDA) and Dow Chemical Corporation for the operation of the Rocky Flats Nuclear Plant and a similar contract, signed in early January, between the AEC and Rockwell International effective June 30, 1975.

This analysis and comparison is limited to those provisions in these lengthy documents which appear to be pertinent to the Task Force's inquiry.

1. Statement of Work.

Article II of the Dow contract provides, in part, that Dow

> shall furnish the personnel, services, materials and equipment. . .necessary for the management and operation of the Commission's Rocky Flats plant and for the performance of the other work described in Appendix B "Scope of Work". . .

Appendix B requires that in performing the work set forth therein, Dow must also, among other things:

> 5. Maintain an effective program relative to all aspects of health and safety in accordance with the requirements of the Commission and good health and safety practices. This program shall include provisions for the safety of facilities and operations so as to provide for the protection of property, Contractor and Commission personnel, and those members

> of the general public which might be affected by plant operations. In addition, develop and maintain emergency plans and procedures as required by the Commission.
>
> * * *
>
> 8. Participate in the Commission's radiological assistance plan, the Commission's weapons accident investigations and other investigations or advisory groups as the Commission may request. In the event of a radiological incident or an accident investigation, the Contractor shall provide such medical, monitoring, and related advisory personnel, as is from time to time agreed by the parties, to serve as participants in the Commission's radiological assistance plan and to support the packaging of accident residue being returned to the Commission by the DOD. While serving as participants, the personnel shall be under the direction of the Commission and may be utilized at off-site locations as may be required.

According to a letter received by the Task Force from Leonard A. Jacobvitz, Chief Counsel of the AEC Albuquerque Operations Office, Article II - Statement of Work of the Rockwell contract "gives the AEC considerably more control over the Contractor than does the comparable Article II of the existing Dow contract."

However, this additional control is not readily apparent from reading the terms of Article II of the Rockwell contract. The Rockwell statement of work provisions do contain additional language by which

> The Contractor undertakes and promises to manage, operate, and maintain the Rocky Flats Plant and to perform said work and services, upon the terms and

> conditions herein provided and in accordance with such directions and instructions not inconsistent with this contract which the Commission may deem necessary and give to the Contractor from time to time. . . .

Perhaps this is the language to which Mr. Jacobvitz was referring in the above-noted letter. However, the contract does not spell out in any specific way the manner in which the AEC intends to exercise this additional control over Rockwell in a manner qualitatively different than its control over Dow.

Paragraph 2C - Related Services of Article II of the Rockwell contract provides that the Contractor shall perform other services as the Commission and the Contractor shall agree in writing from time to time will be performed under this Contract either for the Commission or its Contractor and will render services to federal agencies to the extent it is in a position to do so as requested by the Commission in accordance with such procedures and requirements as the Commission may establish from time to time. These provisions would appear to leave the door open for additional agreements between the Commission and Rockwell for additional health and safety functions not presently being performed by Dow or contemplated to be performed by Rockwell which may be determined to be necessary in accordance with recommendations of the Task Force.

It is also assumed that Appendix B of the Rockwell contract is at least as broad in scope as that of the Dow contract.

However, the Task Force has not been provided with a copy of the Rockwell Appendix B. Presumably, this would include cooperation with a continuing advisory or watchdog committee which the Task Force may recommend to be established.

2. Term, Obligation of Funds and Financial Plans.

The last Dow contract was for a three-year period from July 1, 1972 through June 30, 1975. The initial amount of funds obligated by the government for the period of this contract was $633,734,610.

Under Article III of the Rockwell contract the term of the contract will be for four and one-half years from June 30, 1975 through December 31, 1980. To date, however, it would appear that the exact amount of funds to be obligated by the government has not yet been agreed upon between the AEC and Rockwell. The contract provides that such funds shall be obligated on or before July 1, 1975.

It would appear therefore that there is room for negotiation with respect to particular aspects of this contract and the amount of funds which the government intends to commit to Rockwell for the contract. Hence, the recommendations of the Task Force may greatly influence the amount and nature of the functions included in this contract.

3. Allowable Costs and Fixed Fee.

Both the Dow and Rockwell contracts appear to be in the nature of a cost plus fixed fee contract. Under the Dow contract for fiscal years 1973 and 1974 the fixed fee was $2,240,000. For fiscal year 1975 the fixed fee was $2,280,000. It is significant however that the fee for each fiscal year seems to be the subject of negotiation between the AEC and the contractor, which again leaves some room for modification of the nature of the contract from year to year consistent with recommendations by this Task Force or any subsequent watch-dog committee established in accordance with the Task Force recommendations.

Under Article V of the Rockwell contract the fixed fee for fiscal 1975 has not yet been agreed upon between the parties, again leaving room for adjustments in accordance with acceptance of the recommendations of the Task Force.

The list of allowable and non-allowable costs would appear to be modifiable by agreement by the parties pursuant to the Statement of Work provision to cover those "impact costs" which may be necessary for such things as medical research, contingency plans, monitoring and inspection by state officials and training of radiation personnel, in accordance with any recommendations by the Task Force which are adopted by the AEC and Rockwell, or which are enacted into law by federal or state legislation.

4. Inspections.

Article VIII, Section 6 of both the Dow and Rockwell contracts dealing with Inspections are identical. They provide in general terms that

> The Commission shall have the right to inspect the work and activities of the Contractor under this contract at such time and in such manner as it shall deem appropriate.

The contract provides no guidelines with respect to the frequency and scope of such inspections. There is also no requirement that these inspections be with or without notice to the Contractor or that they be performed by independent government agencies or private inspecting companies. There is also no provision for providing the results of such inspections to the public, to state and local officials or to Congress.

5. Risk of Loss of Government Property.

Article X, Section 6 of both the Dow and Rockwell contracts are essentially identical. They both relieve the Contractor of liability for loss or destruction of or damage to government property in the Contractor's possession unless it is caused by willful misconduct or lack of good faith on the part of the Contractor's managerial personnel or results from the failure of the Contractor's managerial personnel to take all reasonable steps to comply with written directives of the contracting officer to safeguard such property.

Hence, for example, the Contractor is not liable for reimbursing the government for such damage as the $40 to $50 million costs following the 1969 fire at Rocky Flats, despite the fact that such loss may be caused by the negligence of the Contractor.

In addition, under Article XII of the Dow contract and Article XI of the Rockwell contract, the Contractor is not required to procure or maintain for its own protection any insurance (including self insurance or reserve) covering loss or destruction of or damage to government property.

Hence, there would appear to be little incentive for the Contractor to take all reasonable steps necessary to prevent negligent destruction of government property because of risk of incurring personal liability or loss of insurance coverage which would be essential to qualify as the Contractor. In addition, it would appear that the Contractor runs little risk that he will be terminated because of any negligence which might lead to extensive damage and cost at a nuclear plant such as Rocky Flats. This is evident in the fact that the AEC extended a three-year contract to Dow in 1972 involving an obligation of over $633 million without any determination, at least as far as the public or Congress knows, as to the responsibility of Dow for the $40 to $50 million 1969 fire at that plant.

6. State and Local Taxes.

Article XIII of the Dow contract and Article XII of the Rockwell contract have identical provisions with respect to the

payment by the Contractor of state and local taxes. As a federal instrumentality the operations of the Rocky Flats Plant would appear to be exempt from state and local taxes except as provided by federal law or agreed to by the Atomic Energy Commission.

However, in view of the obvious impact costs to state and local governments from the operation of a nuclear weapons plant such as Rocky Flats in Colorado, failure of such a plant to pay any taxes or to reimburse the state for any of its costs would seem to create an unreasonable burden on state resources.

7. Safety, Health and Fire Protection.

Article XVI of the Rockwell contract provides:

> The Contractor shall take all reasonable precautions in the performance of the work under this contract to protect the health and safety of employees and of members of the public and to minimize danger from all hazards to life and property, and shall comply with all health, safety and fire protection regulations and requirements (including reporting requirements) of the Commission. In the event that the Contractor fails to comply with said regulations or requirements of the Commission, the Contracting Officer may, without prejudice to any other legal or contractual rights of the Commission, issue an order stopping all or any part of the work; thereafter a start order for resumption of work may be issued at the discretion of the Contracting Officer. The Contractor shall make no claim for compensation or damages by reason of or in connection with such work stoppage.

However, the following paragraph from a similar provision in the Dow contract (Article XVII), has been omitted from Article XVI of the Rockwell contract:

> The parties have carefully reviewed the operations performed by the Contractor at the Rocky Flats Plant. This article is included in this contract with a clear understanding that such operations involve materials and processes which require that the Contractor exercise the utmost skill to assure safe operating conditions for employees as well as the public. (Emphasis added.)

This latter clause would appear to require a higher standard of care on the part of the contractor than would appear to be required of Rockwell with this language omitted from their contract.

Since Rockwell will be required to comply with all health, safety and fire regulations and requirements (including reporting requirements) of the Commission, there would appear to be room for the Commission to impose standards in this area in compliance with recommendations by this Task Force.

8. Preservation of Individual Occupational Radiation Exposure Records.

Article XVIII of the Dow contract provides:

> Individual occupational radiation exposure records generated in the performance of work under this contract shall be subject to inspection by the Commission and shall be preserved by the Contractor until disposal is authorized by the Commission, or at the option of the Contractor deliver to the Commission upon completion or termination of the contract.

There appears to be no express equivalent provision in the Rockwell contract, nor is there any requirement of public disclosure and availability of such records for research.

9. Permits.

Both Article XIX of the Dow contract and Article XVII of the Rockwell contract provide with respect to permits as follows:

> Except as otherwise directed by the Contracting Officer, the Contractor shall procure all necessary permits or licenses and abide by all applicable laws, regulations and ordinances of the United States and of the state, territory, and political subdivision in which the work under this contract is performed.

This provision would appear to allow the AEC to require Rockwell to comply with any state and local statutes and ordinances pertaining to on-site inspections and monitoring of radioactivity and other health and safety requirements which may be enacted by the Colorado Legislature or Jefferson County with respect to land use or other provisions. Of course, any federal legislation in this area would also have to be followed by the AEC and the Contractor.

10. Nuclear Hazards Indemnity.

Article XXXVII of the Dow contract and Article XLIV of the Rockwell contract are virtually identical with respect to nuclear hazards indemnity. Both provisions essentially incorporate the Price-Anderson Amendments to the Atomic Energy Act. A more detailed analysis of the provisions of those amendments can be found in the section of this report entitled "Analysis of the Price-Anderson Amendments to the Atomic Energy Act and Their Effect Given a Nuclear Incident at the Rocky Flats Plant."

Section 2 of this provision in both contracts provides that the Contractor will not be required to provide or maintain at government expense any formal financial protection to cover public liability unless permitted or required to do so in writing by the Commission. Under the federal statutes, the Commission could require Rockwell to maintain up to a maximum of $60 million now available under two insurance pools. In a letter dated January 27, 1975 to the Task Force from Mr. Jacobvitz, the following explanation is offered as to why the government does not require Dow or Rockwell to maintain any financial protection of its own over and above the$500 million indemnification provided by the government to the Contractor:

> Since the financial burden of private financial protection would fall on the government where an operating contractor is involved, the Commission decided as a matter of policy not to require operating contractors to obtain any such financial protection.

Thus, the Contractor is not subject to any independent safety performance standards upon which continued insurance coverage and possibly eligibility as a nuclear weapons contractor might depend.

Under Section 3A of these Articles, the government has agreed to indemnify the Contractor up to a maximum of $500 million in the aggregate for each nuclear accident occurring within the United States or $100 million in the aggregate for each nuclear accident occurring without the United States, irrespective of the number of persons indemnified in connection with this contract.

Both contracts include a waiver of defenses clause in the event the Commission determines that injury or property damage was caused by an "extraordinary nuclear occurrence." (See Analysis of Price-Anderson Act Amendments.)

II. ANALYSIS OF THE PRICE-ANDERSON AMENDMENTS TO THE ATOMIC ENERGY ACT, AND THEIR EFFECT GIVEN A NUCLEAR INCIDENT AT THE ROCKY FLATS PLANT

Introduction

In 1954, amendments[1/] to the original Atomic Energy Act (hereafter AEA)[2/] permitted private industry to join the field of atomic energy activities, formerly an exclusive province of the federal government. However there were no provisions for insurance or indemnification without which private industry felt it could not go forward. As a result, the Price-Anderson Energy Damages Act of 1957[3/] was passed, as further amendments to the AEA.

Congress found[4/] that regulation of source, byproduct, and special nuclear material[5/] (including plutonium, of primary interest here) was in the public interest, and the necessity for protection against possible interstate damage from use of these materials placed the operation of atomic energy facilities in interstate commerce. Further, it was determined that the federal government could provide funds to cover "a portion of damages suffered by the public from nuclear incidents, and may limit the liability of those persons liable for such losses."[6/]

Scope

Under the scheme of the Act, the United States government agrees to indemnify its contractors and/or licensees for public liability, excluding (i) damages covered by state or federal Workman's Compensation, (ii) claims arising out of an act of war, (iii) loss or damage to use of property at the site and used in connection with licensed activity where the incident occurs.[7/]

Therefore the Act does not come into play unless there is an impact on the offsite public - injuries to employees or damage to on-site property are not within the scope of the Act.[8/]

The Act contemplates two kinds of nuclear accidents: A nuclear incident[9/] and an extraordinary nuclear occurrence.[10/] The indemnification provisions operate in either case. To insure public protection, the Atomic Energy Commission (AEC)[11/] must require its commercial (as well as medical therapy and R & D) licensees to obtain financial protection from private insurance sources.[12/] The requirement for such coverage for contractors (as Rocky Flats management is considered) is discretionary.

Regardless of whether financial protection is required, AEC may require an indemnification agreement as another condition of the license or contract. Until August 1, 1977, the AEC has the authority to enter into agreements of indemnification for $500 million to cover public liability.[13/] The ceiling on aggregate liability for a single nuclear incident, including costs of investigation and the government's defense of damage suits is

$560 million - $1/2 billion from the federal government plus up to $60 million of the amount of financial protection that may be required to be carried by the licensee/contractor. If more than $60 million insurance is required to be carried, the $1/2 billion covered by the government is reduced by the amount of overage above $60 million. E.g., an $80 million requirement would cause a $20 million overage ($80 million minus $60 million), reducing the $500 million governmental coverage to $480 million, thus preserving the statutory maximum of $560 million ($480 million + $80 million = $560 million).

These provisions are effective in the event of a "nuclear incident." If an "extraordinary nuclear occurrence" should take place, the statute allows waivers of defenses[14/] by the licensee/contractor to go into effect. These waivers may, at the Commission's discretion, be a condition of the license or contract.

The Price-Anderson Act does not create a federal cause of action for claimants, nor does it establish strict liability on the part of the contractor for injuries and/or damages. Liability is to be determined under applicable state tort law, although original jurisdiction is granted to the Federal District Courts in the event of an extraordinary nuclear occurrence.[15/]

Interpretation and Foreseeable Problems.

1. Congressional power to limit the liability of the contractor to $560 million.

The federal power of Congress to limit liability of the contractor under state law has been questioned.[16/] It seems clear that the federal government may determine to limit its indemnification of a contractor's activity, but perhaps not the liability.

2. Financial protection by the contractor is within the discretion of the AEC.

Dow Chemical Company, under the existing contract, and Atomics International (division of Rockwell International) under the contract effective July 1, 1975, are not required to carry any financial protection. Under the Act this is a discretionary matter as to contractors, whereas licensees with facilities for producing substantial amounts of electricity must carry the maximum financial protection available from private sources. The Act does not define "licensee" or "contractor," therefore it is difficult to understand why policy would dictate a requirement of financial protection for a nuclear reactor and not for the Rocky Flats Plant which processes and utilizes plutonium for the production of nuclear weapons.

A further question is raised by the fact that the Rocky Flats Plant is engaged in several types of activity, including research in the area of testing criticalities of fissionable materials. The AEC is authorized to arrange for research and development (R & D) in the area of "utilization of special nuclear material and radioactive material for medical, biological, agri-

cultural, health, or military purposes" (emphasis added).[17] A license must be granted for such research. Therefore, the requirement for all licensees to carry financial protection[18] should apply to this aspect of the activities performed at the Rocky Flats Plant.

The AEC contracts do not consider Dow Chemical Company or Rockwell International as licensees, and require no financial protection. If R & D activities are a part of the Rocky Flats operation, AEC's failure to require private insurance coverage in the appropriate amount may be a violation of a nondiscretionary statutory duty.

Under the present contractual agreements, the contractor has no financial responsibility for any accident which may occur: The government indemnifies the contractor for public liability, and in this case has agreed to pay for any damage to its own property on site (see memo on contracts) as in the case of the 1969 fire. Some degree of financial involvement would increase the contractor's incentive to take all possible precautions.

3. Catagorization of the type of nuclear event.

The determination of whether an "extraordinary nuclear occurrence" has taken place is a non-reviewable one made by the Commission according to its own criteria.[19] A system in which there is no provision for independent appraisal or review is susceptible to the promulgation of regulations which meet only narrowly-defined agency objectives.

This issue becomes important since the federal statute leaves the question of liability to the relevant state laws, but makes the availability of common law defenses to the defendant contractor turn on the AEC's characterization of the nuclear event. If it is called a "nuclear incident," the claimants must establish their cause of action and proximate causation of injuries or damages, as well as effectively counter the contractor's affirmative defenses including the claim of sovereign immunity.

If an "extraordinary nuclear occurrence" has taken place, litigation will be affected by waivers of defenses by the defendant contractor as provided for in the contract with AEC (see item 7). This is the case with the present and future contracts for the Rocky Flats Plant.

The plaintiff will have the same burden in either case, but the defendant's right to use affirmative defenses will be affected by the AEC determination. Whether the applicable standard will be negligence or strict liability will depend on the applicable state tort law.

4. Doctrines of state tort law which may establish a claim of action.

The view generally held by commentators is that an action would lie under the doctrine of Rylands v. Fletcher,[20/] where the plaintiff was entitled to recover for damages caused by substances escaping from the defendant's land due to a "non-natural" use. Since Rocky Flats is operated with governmental authorization there may be some question as to whether the doc-

trine would apply.[21] However in Smith v. Lockheed Propulsion Co.[22] the California Supreme Court held that plaintiff's suit for damages to real property was actionable where they alleged causation by seismic vibrations activated by static firing rocket motor tests on adjoining lands owned by a government contractor. The defendant contractor's activity was held to be "ultra-hazardous," a standard of strict liability was applied, and the government contractor was not able to come under the shield of governmental immunity (assuming the government would have been immune from suit under the Federal Tort Claims Act). The circumstances of the Lockheed case are not completely analogous to that of Rocky Flats because in the former there was no evidence that the government chose the testing site or established specifications for the siting decision. AEC was responsible for the siting of Rocky Flats near Golden, Colorado, thus, the Lockheed court's determination that governmental immunity did not extend to the contractor[23] might not be relevant in a Colorado case. Therefore it is not clear whether the defense of sovereign immunity would be available to the contractor where a "nuclear incident" has occurred. Should this be so, the Act would fail to achieve its purpose since claimants would be denied access to the Price-Anderson funds altogether should the Commission determine that an extraordinary nuclear incident did not occur.

Res ipsa loquitur was held not to apply in the Lockheed case because the accident was not of such a nature that it was

probably a result of negligence by someone and that the defendant was probably the one responsible. It is difficult to say whether a nuclear incident is one that may take place without negligence by the contractor. The claimants' cause of action may rest on that question. The appealing aspect of the res ipsa loquitur doctrine is that it accounts for situations where information on the issue of negligence is almost solely within the knowledge of the defendant, and the exclusivity of that knowledge is all the plaintiff is able to show. This is likely to be the case in the event of a nuclear incident at Rocky Flats.

5. Standard to be used to govern recovery and use of waivers of defenses.

If a "nuclear incident" takes place, the contractor may rely on common law affirmative defenses such as contributory negligence, assumption of risk, and possible governmental immunity. Since these defenses are available, it appears the plaintiff must establish negligence to recover.

If a license is required for any of the activities at Rocky Flats, "the Commission may require, as a further condition of issuing a license, that an applicant waive any immunity from public liability conferred by federal or state law."[24/] It is unclear whether this discretionary condition of a waiver of the defense of immunity applies to any "nuclear incident" or only to an "extraordinary nuclear occurrence" as provided for in the 1966 Amendment.[25/]

Waivers of defenses are provided for in the contract with Rockwell International in the event of an extraordinary nuclear occurrence and they include but are not limited to (1)(a) negligence, (b) contributory negligence, (c) assumption of risk, (d) intervening causes; (2) issues or defenses as to charitable or governmental immunity; and (3) statute of limitations not exceeding ten years (see item 8). Some commentators feel that the waivers amount to strict liability.[26/] Others argue that since Congress chose only to provide for waivers of affirmative defenses, strict liability was not intended.[27/] Does the mention of contributory negligence as a defense suggest that negligence is the proper standard? How are such defenses likely to apply to a possible nuclear event, unless living down-wind from Rocky Flats constitutes assumption of risk? It is difficult to see how these defenses are relevant except perhaps in a case of trespass resulting in injury; therefore the requirement of such waivers does not appear to greatly further the purpose of protection of the public.

The difficulties in establishing a cause of action could be met if Congress were to adopt a standard of strict liability[28/] or if the states adopted a statute along the lines of the Uniform Nuclear Facilities Liability Act.[29/]

6. Applicability of the Federal Tort Claims Act.

The FTCA appears not to apply in cases where the contractor is the defendant, and the government joins the action as indemnifier.[30/]

7. Standards of AEC determination of "extraordinary nuclear occurrence."

The regulations promulgated under the AEA[31/] establish criteria for the determination of an "extraordinary occurrence" and conditions for the waivers of defenses and indemnification agreements. These criteria are defined in terms of "substantial" discharge of radioactive material or "substantial" radiation levels off site. The relationship of "substantial" terminology used in the regulations, to the terms "nuclear incident," and "extraordinary nuclear occurrence" of the Price-Anderson statute is not clear. Substantiality is defined in terms of magnitudes of damage to property or injury to persons. It is foreseeable that the AEC's reckoning of damages may not coincide with the assessment of private persons who are affected by a nuclear accident.

According to the Code of Federal Regulations the measure of damages is not tied to the standards promulgated by the AEC or EPA for health and safety regulations.[32/] The damage criteria far exceed those values selected for discharge criteria. Were EPA to adopt a liberal standard for permissible discharge of plutonium, this would not affect the standards for determining an "extraordinary nuclear occurrence." The question is, however, whether the standards promulgated for this determination are adequate. Is it possible for claimants to be denied recovery because the government's assessment of damage is not sufficient to bring the waivers of defenses of immunity, etc. into play?

There needs to be a clarification of the terms and an evaluation of the standards on which the public's access to government indemnification funds rests.

8. Statute of limitations.

The defendant contractor shall waive any issue or defense based on any statute of limitations if suit is instituted within three years from the date on which the claimant first knew or reasonably could have known of his injury or damage and the cause thereof, but in no event more than ten years after the date of the nuclear incident.[33/]

The weakness of this provision lies in the fact that it is nonresponsive to the nature of diseases caused by exposure to radioactive substances which may not develop for 20 to 30 years. Since the suggested statute of limitations in the Model Nuclear Facilities Act[34/] is the same as the one in the statute and the contract, it is also in need of revision.

9. Role of the Courts.

The Price-Anderson statute anticipates litigation in the event of a nuclear incident. Should an extraordinary nuclear occurrence take place, the United States District Court in that location shall have original jurisdiction over any public liability action.[35/] If petitioned by an indemnitor or any interested person with a claim that public liability may exceed the statutory limit ($500 to $560 million), the District Court is to act in the manner of a trustee in bankruptcy: To administer the distribution

of funds. Under the Act[36/] the court may grant orders limiting the liability of indemnified persons, modifying distribution plans, staying payment of claims and execution of court judgments, and apportioning payments to be made to claimants.

10. Investigation of and report on a nuclear event.

After any incident that may require payments under the Act, the AEC is charged with the duty to survey the causes and extent of damages, and make all final findings (excepting "restricted data")[37/] available to the public, parties involved and the courts.[38/]

Due to the classified nature of the activities performed at the Rocky Flats Plant, civil discovery in the course of litigation is apt to be limited. If the claimants must demonstrate negligence, or even causation under a strict liability standard, information about the plant's operation may be extremely relevant. If the discoverable information is limited to the AEC report, claimants may be prejudiced by the absence of any independent assessment of what took place.

11. AEC's final authority on behalf of the United States to settle claims.[39/]

This authority is not one to determine who has a claim against the contractor, but is one which reserves the right of AEC to make a final determination about settlements with claimants.

12. Role for the states.

The statute does not confer upon any federal, state or local agency any authority to regulate, control or restrict any

activities of the Commission.[40] However cooperation between the Commission and the states is provided for, such that the latter may assume some regulatory responsibility with respect to by-product, source and special nuclear material.[41]

One such agreement has been made with Colorado for shared monitoring of liquid effluent discharged from Rocky Flats into waters of the State of Colorado. Such arrangements are only within the discretion of the AEC. Whether the state has any enforceable rights to regulation of federal government contractors operating on federal land within the state's boundaries is an unsettled question.

Colorado Public Interest Research Group, Inc. (COPIRG) v. Train (No. 74-1154, 10th Cir., 373 F.Supp. D.C. Colo. 1974) litigated the question of the Environmental Protection Agency's nondiscretionary duty to control discharges of radioactive materials from the Rocky Flats Plant. EPA had, prior to the suit, deferred to AEC for the purposes of such regulations. The issue was resolved in favor of EPA's jurisdiction under the Federal Water Pollution Control Act.[43]

Since the states have concurrent jurisdiction with EPA to promulgate regulations under the Act, it would appear under this decision that Colorado has the authority, if not the obligation, to monitor discharge into navigable waters for radioactive wastes.[44]

The control of radioactive material in the air is vested in the AEC under the Federal Air Pollution Control Act.[45] It is

not clear whether any jurisdiction of EPA and/or the states could be found in this area.

Since the regulatory jurisdictions are not consistent as to air and water, at this time it is difficult to identify proper responsibility for radioactive materials found in the soil - resulting from discharge into either air or water. A clarification of this situation would be helpful.

13. The Energy Reorganization Act of 1974.

AEC has now been replaced by the Energy Resource and Development Administration and the Nuclear Regulatory Commission under the Energy Reorganization Plan of 1974.[46/] There is a need to determine whether the organizational change, in an attempt to separate the research and development activities from the regulatory ones, will have an impact on the provisions of the Price-Anderson Act of 1957. For an analysis of the new legislation see Appendix D.

FOOTNOTES

1. P.L. 83-704, 42 U.S.C. 2011 et seq. (1954).

2. P.L. 79-585, 42 U.S.C. 1801-1819 (1946).

3. 42 U.S.C. 2012, 2014, 2039, 2073, 2210, 2232, 2239.

4. 42 U.S.C. 2012.

5. Defined in 42 U.S.C. 2014 (e), (z), (aa).

6. 42 U.S.C. 2012 (i).

7. 42 U.S.C. 2014 (w).

8. If the state's Workman's Compensation laws do not fully cover this area, arguably Price-Anderson would apply. A problem is whether the existence of inadequate Workman's Compensation laws would bar access to the Price-Anderson funds.

9. 42 U.S.C. 2014 (q) "nuclear incident" -- any occurrence, including an extraordinary nuclear occurrence within the U.S. causing within or without the U.S., bodily injury, sickness, disease or death, or loss of or damage to property or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive or other hazardous properties of source, special nuclear or byproduct material.

10. 42 U.S.C. 2014 (j) "Extraordinary nuclear occurrence"-- means any event causing a discharge or dispersal of source, special nuclear or byproduct material from its intended place of confinement in amounts offsite, or causing radiation levels offsite, which the Commission (AEC) determines to be substantial, and which the Commission determines has resulted or will probably result in substantial damages to persons offsite or property offsite. Any determination by the Commission that such an event has or has not occurred shall be final and conclusive, AND no other official or any court shall have power or jurisdiction to review. . . (Emphasis added.)

11. Reference will be made to the Commission or AEC as used in the Act, despite the fact that the AEC has been replaced by the Energy Resource and Development Administration and the Nuclear Regulatory Commission under the Energy Reorganization Act of 1974 (P.L. 93-438).

12. 42 U.S.C. 2210 (a), 42 U.S.C. 2014 (k). The term "financial protection" means the ability to respond in damages for public liability and to meet the costs of investigating and defending claims and settling suits for such damages.

13. 42 U.S.C. 2210 (d).

14. Waiver of defenses with respect to any extraordinary nuclear occurrence to which the contract applies which (a) arises out of or results from or occurs in the course of the construction, possession, or operation of a production or utilization facility, or (b) arises out of or results from or occurs in the course of transportation of source material, byproduct material, or special nuclear material to or from a production or utilization facility, or (c) during the course of the contract activity, arises from the possession, operation, or use by a Commission contractor or subcontractor of a device utilizing special nuclear material or byproduct material. 1966 Amendment to Price Anderson, 42 U.S.C. 2210 (n)(1). See memo on specific contracts for Rocky Flats operation.

15. 42 U.S.C. 2210 (n)(2).

16. Western Interstate Nuclear Board, Plowshare Technology Assessment, Legal Studies, Vol. III. David E. Engdahl, "Deficiencies of Price-Anderson Protection for Plowshare," at 366.

17. 42 U.S.C. 2051 (a)(3).

18. 42 U.S.C. 2210 (a).

19. 10 C.F.R. 140, et seq. (1974). See Appendix B.

20. L. R. 3 H. L. 330 (1868).

21. David F. Cavers, Improving financial protection of the public against the hazards of nuclear power, 77 Harv. L. Rev. 644 (1964).

22. 247 Cal. App.2d 774, 56 Cal. Rptr. 128 (1967).

23. Ibid. at 791.

24. 42 U.S.C. 2210 (a).

25. 42 U.S.C. 2210 (n).

26. Jacob M. Denaro, Fission fuses with insurance, 1969 Insur. L.J. 207. Leonard M. Trosten, William T. England, Waiving Defenses: a new approach to protecting the public against financial loss from the use of atomic energy, 27 Fed. Bar. J. 27 (1967). (JCAE counsel and professional staff member).

27. Harrop A. Freeman. A means of stopping silent murder. 48 J. Urban Law 701 (1971).

28. Cavers, see n. 21. Before the waivers amendment (1966) was passed Cavers urged the adoption of a federal strict liability standard, see proposed draft at 675.

29. Handbook of the National Conference of Commissioners on Uniform State Laws, at 228 (1961). See Appendix A.

30. See Cavers at n. 21. 21 ALR 3d 1356. Tort Liability Incident to Nuclear Accident or Explosion.

31. 10 C.R.F. 140.81 et seq. (1974) subpart E. See Appendix B.

32. 10 C.F.R. 140.81 (1974).

33. 42 U.S.C. 2210 (n) (1) (iii).

34. See n. 29, Appendix A.

35. 42 U.S.C. 2210 (n) (2).

36. 42 U.S.C. 2210 (o) (3).

37. 42 U.S.C. 2014 (y). The term "Restricted Data" means all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy...

38. 42 U.S.C. 2210 (i).

39. 42 U.S.C. 2210 (h).

40. 42 U.S.C. 2018.

41. 42 U.S.C. 2021 (a) (4).

42. Memorandum of Understandings Between the State of Colorado and the United States Atomic Energy Commission, January 24, 1974.

43. As amended, 33 U.S.C. 1251 et seq. (Supp. 1973).

44. 33 U.S.C. 1370. See Appendix C.

45. 42 U.S.C. 1857 et seq., and Exec. Order No. 11282, May 26, 1966, 31 FR 7663.

46. P.L. 93-438 (Oct. 8, 1974).

III. RADIATION CONTROL STATUTE (TITLE 25, ART. 11, SECTION 101-105, COLORADO REVISED STATUTES, 1973).

1. The governor is authorized to enter into agreement with the federal government, for the state to assume exclusive responsibilities within Colorado for protection of persons and property from the hazards of radiation. The governor is also empowered to enter agreements with other states or interstate agencies, as well as the federal government, to share responsibility of inspection "or other functions relating to control of sources of ionizing radiation." None of these transfers by agreement can impose on the health department any responsibilities inconsistent with its duties as delineated under the radiation control article.

2. Powers and duties of the health department regarding radiation control:

a. To issue licenses to handlers, and require registration of sources.

b. To institute personnel training programs to carry out the purpose of the article; the department (may) make such personnel available for participation in federal, in other states, and in interstate programs.

c. In the event of an emergency relating to the source of radiation that endangers peace, health or safety, the department has authority to issue appropriate orders, including embargo on or impounding of materials and sources in the possession of any person "not equipped to observe, or who fails to observe" the provisions of the article or department regula-

lations promulgated under its terms.

d. The Department has power to enter into property of any licensee or registrant to determine compliance. Agencies of the federal government (or their representative) are specifically exempted from this provision (but not from any other provision) and entry authorized only upon permission. This is the only area which specifically exempts federal facilities.

e. Regarding concentration, storage, or permanent disposal of radioactive materials. The Department is empowered to acquire lands, building and grounds for a term up to 99 years for such purposes. Department may delegate the operation of the facilities to private persons or corporations (with approval of state engineer). Fees for license shall be based on costs to the state to supervise such facility, and shall include an annually-adjusted amount to be paid to local governmental units in compensation for loss of valuation for assessment. The lease agreement may also include a security requirement for the fees anticipated for the term of the lease, and a bond to cover tortious acts committed during the term of the lease. Public hearing must be held prior to issuance of any lease or license. But all such facilities are to be owned in fee simple absolute by the state and the radioactive material contained therein will become the property of the state, to be controlled by the state through the health department.

f. Rules and regulations: The State Board of Health shall promulgate rules relating to:

1. licenses and registration
2. records
3. permissible levels of exposure
4. notification and reports of accidents
5. technical qualifications of personnel
6. handling, transportation and storage
7. waste disposal
8. posting and labeling of hazardous sources and areas
9. surveys
10. monitoring

All such regulations shall be modeled after those proposed by the national "council of state governments" unless the Board concludes, on the basis of detailed findings, that a substantial deviation is warranted and that such deviation would permit utilization of sources of radiation without harm to health and safety to any persons who might otherwise be exposed.

Rules and regulations adopted shall never be construed to apply to the kind and amount of radiation intentionally applied for diagnosis or theraputic purposes by a practitioner of the healing arts.

g. Provision is made for a radiation advisory committee (9 members: 3 from industry, 3 from healing arts and 3 from public and private higher education) appointed by the governor, to furnish the Department with advice on radiation control proceedings.

The Department has injunctive power, exercised by Attorney General at the request of the Department, through district court, by means of injunction or order of compliance.

h. Violations and penalties: Acquiring, owning, possessing, or using any radioactive material without a license, or transferring or disposing of such material without approval of the Department of Health, or using, manufacturing, producing, receiving or sending, owning or possessing any source of radiation by a person without a license or registration, is punishable as a misdemeanor (fine of from $100 to $500, and/or imprisonment from 30 to 90 days).

i. Exempted from the sections dealing with powers and duties of the agency, and rules and regulations adopted by the Health Department as to radioactive materials are:

1. certain electrical equipment that produces a small, non-critical amount of radiation;
2. radiation machines during manufacture or transit;
3. radioactive material in transit that is in conformity with AEC or ICC regulations;
4. sound and radio waves and visible infrared and ultraviolet light.

However, no exemptions are to be granted under the section for quantities or activities that do not comply with AEC regulations.

Conclusions

Since the only restriction on the Colorado Department of Health vis a vis the federal government facilities or its duly designated representative appears in 25-11-103 (6) limiting

the right to enter and inspect for the purpose of determining compliance, it appears the state does have the power (under provisions of the act, and setting aside any considerations of the constitutionality of the Act under a theory of separation of powers or preemption) to issue appropriate orders in an emergency situation including orders to lay an embargo on or impound radioactive materials in the possession of anyone who fails to observe any rules and regulations promulgated under the statute.

Under the terms of 25-11-103 (7) (b), the Department has the authority to control with private persons or corporations for the operation of sites and facilities for the storage, concentration, or permanent disposal of radioactive materials within the state, if such disposition is consistent with adequate protection of the public health and safety and if there is approval by the state engineer.

These restrictions are mandated because "it is recognized by the general assembly that any site used for the concentration, disposal, or storage of radioactive material and the contents thereof will represent a continuing and perpetual responsibility involving the public health, safety and general welfare" (25-11-104 [7] [h]). It seems inconsistent for the state to limit its right to regulate in furtherance of an obligation it has recognized and assumed on behalf of its citizens, by exempting federal lands and facilities within the state from state standards.

IV. What state and county powers may be exercised in the regulation and control of the transportation of nuclear materials?

CONCLUSION: The State presently exercises little control over the transportation of nuclear materials. The State power that has been affirmatively exerted in this area was assumed from the Atomic Energy Commission, under provisions of the Atomic Energy Act of 1954, as amended, and is basically confined to transportation in intrastate commerce. The counties do not exercise any power over the transportation of such materials, although a limited delegation of this power may be found in in the Colorado Disaster Emergency Act of 1973.

A determination of the additional regulatory powers which may be assumed by state and local governments, requires consideration of the doctrine of federal pre-emption and other constitutional principles. Although additional research must be conducted in this area, particularly with regard for specific regulatory aspects, it is noted that favorable arguments may be raised against the proscription of expanded state powers, under these constitutional principles.

ANALYSIS:

I. General Analytical Scope

The consideration of the participation of state and county governments in regulating and controlling the transporting of nuclear materials involves sophisticated analyses of the scope and content of existing federal and state legislation, their respective rules and regulations, and the application of the doctrine of federal pre-emption as well as other relevant constitutional law principles. Due to constraints on time and technical expertise, this review is limited to an examination of the basic subject state and county governmental powers that are presently exercised in relation to the Atomic Energy Act of 1954, as amended, and the Federal Transportation of Explosives Act, respective state legislation, and the rules and regulations pertaining to both levels of legislation.

The Motor Carrier Act of 1935, federal statutes concerning railroad safety appliances, 45 U.S.C. § 1 et seq., 42 U.S.C. 43 and 49 U.S.C. § 26, the Dangerous Cargo Act, 46 U.S.C. § 170, and federal statutes authorizing regulation of the air transportation of nuclear materials by the Federal Aviation Agency; 49 U.S.C. 7 1421, § 1430 and § 1472(h), were not reviewed, although they are considered in source materials that were used to address the issue of federal pre-emption. See generally Pollock and Rogers, (Western Interstate Nuclear Board), ed., Transportation of Radioactive Materials in the Western States, 68-77 (1974), [hereinafter cited as Transportation of Radioactive Materials].

The case law and secondary materials involved in the question of what powers the state and local governments may constitutionally

exercise in view of the federal supremacy clause were not examined first hand; instead, heavy reliance was placed on the analyses of these issues as presented in Transportation of Radioactive Materials. Also, as the delineation of powers which may be exercised by the local governments is a function of the extent of the state power in this regulatory area, the focus of the following disucssion primarily concerns the description of state powers.

II. Federal Legislation Concerning the Transportation of Radioactive Materials.

A. The Transportation of Explosives Act, 18 U.S.C. § 831 et seq. 18 U.S.C. § 835.

This Act sets forth basic requirements for the transporting of explosives and other dangerous materials by interstate carriers, and provides for the formulation of regulations for the safe transportation of such materials. [Although the duties of the Act were initially placed with the Interstate Commerce Commission, they were transferred to the Department of Transportation (D.O.T.) when it was created. See 49 U.S.C. § 1655(e)(4).] Radioactive materials are included under the class of dangerous articles in the Act, but radioactive materials shipped "by or under the direction or supervision of the Atomic Energy Commisiion or the Department of Defense which is escorted by personnel specially designated by or under the authority of the Atomic Energy Commission or the Department of Defense, as the case may be, for the purpose of national security" remain exempt from the Act. 18 U.S.C. § 832(c). Under 18 U.S.C. § 834 (e), D.O.T. is authorized to avail itself to the "advice and assistance" of state and local governments.

D.O.T. has developed extensive regulations pursuant to this Act. 49 C.F.R. 170 et seq., 49 C.F.R. 179. Safety standards have been adopted by the D.O.T. for all radioactive packages and contents, and for such packaging classification, labeling and marking, excluding certain materials and areas of technical competence which are administered by the Atomic Energy Commission (A.E.C.). The D.O.T. has also developed "safety standards governing mechanical conditions of carrier personnel, carrier loading, unloading, handling and storage of radioactive material, and any special transport controls to be provided during carriage, including construction standards for transport vehicles." Transportation of Radioactive Materials, supra at 36-37. The D.O.T. has adopted regulations "imposing on shippers and carriers subject to its jurisdiction, safety standards developed by both D.O.T. and A.E.C." Id.

B. The Atomic Energy Act of 1954 (as amended), 42 U.S.C. 2011 et seq. 42 U.S.C. 2296.

One of the stated purposes of this Act is to provide for a program for Government control of the "possession, use, and production of atomic energy and special nuclear material, whether owned by the

Government or others "to essentially maximize the national welfare and security", 42 U.S.C. 32013(c). The A.E.C. regulates the transportation of byproduct, source and special nuclear materials through its licensing requirements. The Act specifies that licenses must be obtained for the transfer or receipt of such nuclear materials in interstate commerce, as well as for the transfer, delivery, receipt of possession or title to, or import or export of any such materials. See 42 U.S.C. § 2073(a), § 2092, and § 32111. Certain small quantities and specific products are exempt from the licensing requirements, 10 C.F.R. § 71.6 et seq. 10 C.F.R. § 71.10.

Basically, the D.O.T. rules and regulations for the transportation of nuclear materials are used for the licensing requirements specified under the Act. The A.E.C. has developed requirements for the transportation and shipping preparation of "fissile materials (uranium-233, uranium-235, plutonium-238, plutonium-239, and plutonium-239, and for quantities of licenses materials in excess of type A quantities, as defined in 371.4(q)". 10 C.F.R. 71.1(a). The latter regulations are in addition to the former, rather than as a substitution for them. 10 C.F.R. 71.1(b).

State Regulation of the Transportation of Radioactive Materials.

In 1959, the Atomic Energy Act of 1954 was amended to include a section providing for cooperation between states and the A.E.C. in the regulation and control of nuclear materials. Under 42 U.S.C. § 2021(b), the A.E.C. is authorized to enter into agreements with states, to allow the latter's assumption of the regulation of byproduct, source, and special nuclear materials in quantities not sufficient to form a critical mass. Id. However, the following responsibilities cannot be discontinued by the A.E.C., 42 U.S.C. § 2021(c):

> "(1) the construction and operation of any production or utilization facility;
>
> (2) the export from or import into the United States of byproduct, source or special nuclear material, or of any production or utilization facility;
>
> (3) the disposal into the ocean or sea of byproduct, source, or special nuclear waste materials as defined in regulations or orders of the Commission;
>
> (4) the disposal of such other byproduct, source or special nuclear material as the Commission determines by regulation or order should, because of the hazards or potential hazards thereof, not be so disposed of without a license from the Commission."

The regulation of the military application of atomic energy is also precluded from state control under a cooperation agreement.

In addition to noting these inroads into potential state regulatory powers, it is more importantly noted that the A.E.C. may grant exemptions for licensing requirements, 42 U.S.C. § 2021(f), and may actually suspend or terminate an agreement with a state "if the Commission finds that such termination or suspension is required to protect the public health and safety,. [42 U.S.C.§ 2021(j)]. Notice and a hearing must be provided before such an agreement can be suspended or terminated. Id.

In 1965, Colorado passed legislation authorizing the Governor to enter into an agreement with the A.E.C. to enable Colorado's assumption of "any and all responsibilities within the state of Colorado relating to the protection of persons and property from the hazards of radioactive materials and other sources of ionizing radiation" from the federal government. 25-22-102(1) C.R.S. 1973. Moreover, the Governor is authorized to enter into agreements with the federal government, other states or interstate agencies to provide for the state health departments functioning in the control of radioactive materials 25-11-102(2) C.R.S. 1973. In 1968, pursuant to this legislation, the Governor and the A.E.C. entered into a cooperation agreement to allow for the state's regulation of radioactive materials as defined under the Atomic Energy Act of 1954, as amended.

The Colorado legislation designates the State Department of Health as the Colorado radiation control agency, and specifies its duties and powers. The following are particularly noted, as it may be asserted that the regulation of the transportation of nuclear materials is an aspect under them:

> "Pursuant to rules and regulations as provided in Section 25-11-104, the Department shall issue licenses pertaining to radioactive materials and require registration of other sources of ionizing radiation." ... 25-11-103(2) C.R.S. 1973; and
>
> "The department shall develop and conduct programs for evaluation and control of hazards associated with the use of any and all radioactive materials and other sources of ionizing radiation." 25-11-103(3) C.R.S. 1973.

However, in 1961, the A.E.C. also promulgated a set of criteria for the states for entering into cooperation agreements and the following stipulation is included:

> "The state shall to the extent of its jurisdiction, promulgate regulations applicable to the shipment of radioactive materials, such regulations to be compatible with those established by the Federal Government...whose jurisdiction over interstate shipment of such materials necessarily continues."
>
> "Criteria for Guidance of States and the A.E.C. in the Discontinuance of A.E.C. Regulatory Authority over Byproduct, Source, and Special Nuclear Materials in Quantities, not Sufficient to Form a Critical Mass and the Assumption thereof by States, through Agreements: [March 21, 1961 C.C.H. Atomic Energy Law Reporter, 16, 573].

Accordingly, the State clearly limited its assertion of any control over the transportation of radioactive materials to intrastate transportation. Section 3.22.1, Rules and Regulations Pertaining to Radiation Control, Colorado State Board of Health (1970), states as follows:

> "The provisions of this regulation (RH.22) apply to transportation of radioactive materials, or the delivery of radioactive material to a carrier for transportation, which is not subject to the rules and regulations of the U.S. Department of Transportation and other agencies of the United States having jurisdiction."

Moreover, under Section RH 3.22.2, the State adopts the respective D.O.T. rules and regulations [46 C.F.R. § 146, 49 C.F.R. § 173-179, and 14 C.F.R. § 103] for such intrastate transportation that it regulates.

Thus, in summary, the federal statutory language of the Atomic Energy Act of 1954, as amended, on its face, encourages the state regulation of specified radioactive materials through the state's assumption of the A.E.C.'s licensing authority. Furthermore, as some of the licensing requirements concern the transportation of radioactive materials, it would initially appear that the state may assume some of the power to control this activity within its boundaries. However, the criteria for establishing cooperation between the state and the A.E.C., set forth limitations on the state's jurisdiction over this activity.

Although the 1973 Colorado radiation control legislation broadly describes the nature of regulatory duties and powers which can be exercised in assuming the A.E.C.'s licensing responsibilities, the respective rules and regulations follow the A.E.C.'s cooperation agreement criteria, and limit the state's power to control the transportation of radioactive materials to intrastate transportation activities.

IV. County Regulation of Transportation of Radioactive Materials.

Basically, a county is a political subdivision of the state and may exercise only those powers which are expressly conferred upon it by the state constitution and statutes, and those implied powers which are reasonably necessary to carry out the express powers. Board of County Commissioners vs. Love 172 Colo. 121, 470 P.2d 861 (1970). Thus, any county power in the area of the regulation of the transportation of radioactive materials must be delegated to the county by the state.

To date, counties have not attempted to assume the control of such regulation. However, the delegation of the power to control, may be asserted under certain provisions of the Colorado Disaster Emergency Act of 1973. 28-2-101 C.R.S. 1973 et seq. 28-2-115 C.R.S.

1973. The purpose of the Act is to "authorize and provide for coordination of activities relating to disaster prevention, preparedness, response, and recover" by all levels of state government. 28-2-102 C.R.S. 1973. Disaster is defined as the "occurrence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural or man-made cause..." 28-28103(1) C.R.S. 1973.

Thus, it may be argued that an accident occurring during the course of transporting radioactive materials is a disaster within the meaning of the Act. As the Act authorizes local governments to take measures for disaster prevention, it may be asserted that such provision allows the county to set forth regulations for the transportation of radioactive materials in an effort to prevent related accidents. However, as the county can only exercise powers delegated to it by the state, such regulatory powers cannot be greater than those recognized by the state. Therefore, such powers over transportation would necessarily be limited to the area of intrastate transportation, as the state itself is limited. Also, it would have to be determined that such delegation would adequately serve the public welfare, as required under the Atomic Energy Act of 1954.

V. Assumption of Additional Powers by State and County Governments.

The assumption by the state and county governments of additional regulatory powers over transportation of radioactive materials depends upon whether or not federal pre-emption exists in the control of interstate carriers involved in this activity. As noted above, a review of the relevant constitutional law doctrines was not possible at this preliminary stage of the legal subcommittee's report. However, some of the views from Transportation of Radioactive Materials, supra, are presented. These views support the extension of state power and certainly must be weighed against the perhaps more traditional argument that such extensive federal legislation and regulations preclude concurrent state regulatory powers.

Several federal statutes are considered in analyzing the question of federal pre-emption because under the modern doctrine, the congressional intent indicated in such legislation, rather than the fact that Congress has occupied the field of regulation, determines whether or not compatible state legislation may be concurrently enacted. Id. at 56. Although it is recognized that some regulatory aspects of radioactive materials are pre-empted under the Atomic Energy Act of 1954, several arguments are presented to support the state's jurisdiction over transportation. Id. at 62-64. However, the nebulousness of the requirement in the A.E.C.'s cooperation agreement criteria that the state transportation regulations must be "compatible" with federal regulations and the A.E.C.'s authority to suspend or terminate the agreements are posed as potential constraints on the state's actual extension of such powers, Id. at 64-66.

It is suggested in Transportation of Radioactive Materials, supra, that the question of federal pre-emption in this area cannot be answered without reviewing other applicable legislation, as mentioned in the first section of this memorandum. The analysis of such legislation again results in a positive finding for the role of states in the control of transporting radioactive materials through either express provisions for state regulation, or by implication. See generally, Transportation of Radioactive Materials, supra, at 67-77. However, the following caveat is raised against a heavy reliance on such broad considerations, emphasizing the need to analyze the specific types of desired state controls before reaching realistic conclusions:

> The foregoing discussion indicates that as a general proposition, there seems to be nothing in the federal statutes governing nuclear materials transportation to prevent states from adopting and enforcing state regulations duplicating or supplementing the federal regulations as they apply within the respective states' territory, whether the transportation be by motor vehicle, by rail, by water, or by air. "General propositions," however, are not sufficient to resolve particular questions; even though state power over such transportation has not generally been pre-empted, there remains the possibility that particular state regulations, or particular kinds of state regulation, might prove to be in irreconcilable conflict with particular federal regulations, and therefore be pre-empted. A definitive estimate on the question of pre-emption is impossible except with respect to an actual particular state regulation the peculiar wording and practical operation of which have been ascertained. Id. at 77.

Some specific controls that may be upheld under a pre-emption argument are special speed limit impositions on vehicles carrying nuclear materials, advance notification requirements of shipments, specifications for escorts during transportation, and state assistance and inspection of federal regulations. Id. at 78-80.

The issue of state control must also be examined in view of two other constitutional doctrines. The doctrine of governmental immunity basically bars states from regulating activities undertaken by the federal government. The doctrine has been extended to cover government contractors, although there has been a tendency to limit the class of government contracts to those contractors who contemplate the receipt of a service from the government for their benefit, Id. at 53. Thus, this doctrine poses a strong argument against state control over any government activities, including those activities of government contractors in transporting nuclear materials Id. at 51.

Under the principle of "negative implications of federal power," state regulations may be challenged, even though the federal government has not exercised its regulatory power in the area.

The modern test used to determine whether state regulations can be negated by the commerce, uses the following three criteria:

1) Is the state objective valid?

2) Is the regulation conducive to achieving the objective?

3) Does the effectiveness of such regulation to achieve a valid objective, outweigh the burden or inconvenience placed upon interstate commerce? Id at 81-82.

It is indicated that the results of the application of such criteria to a state regulation of the transportation of nuclear materials, are rather uncertain due to the discretionary considerations involved Id. at 83. However, it is noted that recent United States Supreme Court decisions tend to consider the third criteria a legislative judgment, lending a more favorable view of state regulations; but the problems of the potential imposition of diverse state regulations may remain a significant weakness of the states' argument for control in this area, Id. at 83-84.

RECOMMENDATIONS: It is the feeling of our group that several issues need to be given further study by the legal subcommittee.

1. State of Colorado - First, the whole federal pre-emption question should be defined. The A-95 directive may be an entry point for the state and local governments to participate in management decisions of Rocky Flats. That question should be resolved.

2. State of Colorado - Evaluate the adequacy of the present Department of Transportation and the Atomic Energy Commission's regulations and enforcement provisions.

3. State of Colorado - Examine the doctrine if pre-emption an other constitutional law principles which may impose limitations of the state control over the transportation of radioactive materials.

4. State of Colorado and/or Local Jurisdiction - The need to protect citizens from radiation hazards, demands an immediate study to determine the size of the protective ring around the Rocky Flats Plant. The zoning enabling legislation seems to permit the establishment of a special hazardous zone. The other alternative is to get the Atomic Energy Commission to acquire more ground around the 10,000 acres they now own.

5. Local Jurisdiction - Look into the Health Department's standards for exposure to radiation, to determine whether the county would prefer higher standards.

6. Local Jurisdiction - Use the Disaster Emergency Act to implement a county, local or interjurisdictional disaster plan, if one has not been implemented. If there is a local or county disaster plan, it should be scrutinized for possible modification. Not only must there be a disaster plan, but there must also be a clear chain of command and monitoring system. Each person and agency involved in the plan must know their role.

7. Local Jurisdiction - Determine the capability of county governments to assume the regulation of the transportation of radioactive materials.

V. What powers are there for local governments to regulate land use around the Atomic Energy Commission's Rocky Flats facility?

FACTS: There are four areas of regulation that relate to controlling development near the Rocky Flats facility:

1. Planning
2. Zoning
3. Subdivisions
4. Building Code

I. County Planning

C.R.S. 30-28-110 Regional planning commission approval, required when recording. (1)(a) "...whether publicly or privately owned, shall be constructed or authorized in the unincorporated territory of the county until and unless the proposed location and extent thereof has been submitted to and approved by such county or regional planning commission..."

Question #1: Is there an entry point for local government if there is an addition to the facility which would be contrary to a master plan?

Conclusion: Because of federal pre-emption, there appears to be little area under the C.R.S. for counties to have a say in on-site activities. The entry point could be the A-95 directive. This is an area where further study is indicated. Off-site controls are quite specific. The county master plan can deal with any or all off-site impacts.

II. County Zoning

C.R.S. 30-28-113 Regulation of size and use - districts. (1) "...public activities, or other purposes, and the uses of land for trade, industry, residence, recreation, or other purposes and for flood control. ...plans for those parts which it deems to be urbanized or suitable for urban development and those parts which, by reason of distance from existing urban communities or for other causes, it deems suitable for nonurban development..."

Question #2: Can the county zone on-site and off-site, under a special use district?

Conclusion: The county could zone for such a facility such as Rocky Flats plant. It can also zone for off-site efforts of the plant. The zone size would have to have a direct relation to the hazards presented by the plant.

III. Subdivision Enabling Statute (Senate Bill 35)
C.R.S. 30-28-119 (c) "...in the manner prescribed in section 30-28-112. Thereafter the board of county commissioners may by resolution exercise, as to the territory included within the boundaries of such district, all the powers conferred upon it by sections 30-28-113 to 30-28-115 and may amend said resolution from time to time, but any such amendment shall not be made or become effective unless the same has been proposed by or first submitted for the approval, disapproval, or suggestions of the district planning commission and shall likewise have approval by the county planning commission if one has been created. If any such amendment is disapproved by either the county or the district planning commission within thirty days after such submission, to become effective it shall receive the favorable vote..."

C.R.S. 30-28-133 Subdivision regulations. (1) "...All subdivision regulations, and all amendments thereto, adopted by a board of county commissioners shall be transmitted to the Colorado land use commission..."

Question #3: Can the county regulate subdivision near Rocky Flats?

Conclusion: The county can regulate or stop subdivisions where the contamination exceeds certain levels established by the State Health Department.

IV. Building Code
C.R.S. 30-28-202. Designation of zoned area - hearing. (1) "... may designate part or all of the county for the adoption of a building code..."

C.R.S. 30-28-203 Purpose of codes. "The provisions of any building code shall be made with a reasonable consideration of, and in accordance with, the public health, safety, morals, and general welfare and the safety, protection, and sanitation of such dwellings, buildings, and structures."

C.R.S. 30-28-206. Board of review - qualifications - powers. (2) "...in appropriate cases and subject to appropriate principles, standards, rules, conditions, and safeguards set forth in the building code, may make special exceptions to the terms of the building code in harmony with their general purpose and intent. The board of county commissioners also may authorize the board of review to formulate suggested amendments to the building code for the consideration of the board of county commissioners. In addition, the board of review may adopt substantive rules and regulations based on the provisions of the building code adopted by the board of county commissioners..."

Question #4: Does state law allow counties the prerogative to apply radiation standards to the building code?

Conclusion: The statutes adequately provide for a county to effect and enforce a strong building code. The health and safety provision is the entry point.

V. State Role

C.R.S. 30-28-133. Subdivision regulations. (2)(b) "...relevant site characteristics...geologic characteristics ...In areas of potential radiation hazard to the proposed future land use, evaluations of these potential radiation hazards;...Maps and tables concerning suitability of types of soil in the proposed subdivision, in accordance with the national cooperative soil survey;... potability of the proposed water supply..."

C.R.S. 24-65-104-2 (a,b,c) "...Colorado Land Use Commission, under the Temporary Emergency Provision, has the power to regulate development in dangerous areas..."

House Bill 1041 - Matters of State Interest. Radioactivity under geologic hazard areas, "term includes but not limited to" natural occurring radiation hazards.

Question #5: What state power can be brought into effect due to inaction on the part of local government?

Conclusion: The Rocky Flats facility probably could not be designated by the county or the Land Use Commission as a matter of state interest under geologic hazards. It is excluded by definition. Of course, the Temporary Emergency Provision and the investigatory powers of the Land Use Commission could be used to regulate any and all off-site development.

COLORADO LAND USE COMMISSION

MEMORANDUM

TO: Legal Subcommittee of the Rocky Flats Citizen Task Force

DATE: January 3, 1975

FROM: Barbara N. Pisanko, Law Clerk

SUBJECT: Rocky Flats Task Force Report

ISSUE: Do local governments in Jefferson and Boulder counties presently have any powers to control potential and actual emergency situations connected with the Rocky Flats installation?

CONCLUSION: Local governments presently may have sufficient power to control any emergency situation, if the issues of the applicability of federal pre-emption and the extent of state control over federal lands are resolved in the state's favor.

ANALYSIS: Douglas H. Parker stated in his article, "The Need for State Atomic Energy Programs in the West",[1] that, "...some sources of radiation are under AEC control and other sources are under state control, but radiation is radiation, regardless of its source and the potential hurt from overexposure is the same. In accord with the traditional location of public health and safety in the jurisdictional domain of the states, the national government may be expected to relinquish their present jurisdiction over the public health and safety problems, with regard to sources of radiation under their control, if the states manifest the ability and serious awareness of the problem necessary to intelligent responsibility. Until the time comes, this is an extensive area in which the states and the AEC must work side by side with each other as co-sovereigns." [1 CCH Atomic Energy Reporter 2504,2505, 2553 (1957)].

Under present Colorado law, the State Department of Health is authorized "to establish and enforce standards for exposure to environmental conditions, including radiation, that may be deemed necessary for the protection of the public health." [C.R.S. 1973 25-1-107(1)(t)] [Emphasis added] But under the same article, local governments are given authority to impose and enforce higher standards than are imposed by the State Department of Health. [C.R.S. 1973 25-1-110] So, if a local government makes a determination that higher standards for exposure to radiation are necessary for the public health and safety, then, that local government has statutory authority to set out and enforce higher standards. Both the state and county health departments are authorized to take legal action to enforce their standards. [C.R.S. 1973 25-1-112 and 25-1-512] The district attorney of the judicial district in which a cause of action arises, is given the primary responsibility for instituting civil and criminal actions; but the executive

director on the state level and the public health officer on the county level, also have authority to bring such actions, if the district attorney fails to act.

Also under present Colorado law, the state and municipalities have power to regulate the rules and regulations which govern county public hospitals. [C.R.S. 1973 25-3-304] Thus, a local emergency disaster plan for the local hospitals could be developed, and the state or the appropriate municipality would have the authority to impose uniform regulations on local hospitals.

In 1973, the legislature passed the Colorado Disaster Emergency Act [C.R.S. 1973 28-2-101-115], which created state, county, local and interjurisdictional powers to create and implement disaster plans for prevention, preparedness and management of emergency situations. This Act gives very broad powers in very broad areas -- "disaster" is defined as "occurence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural or man-made cause, including but not limited to fire, flood, earthquake, wind, storm, wave action, oil spill or other water contamination requiring emergency action to avert danger or damage, volcanic activity, epidemic, air contamination, blight, drought, infestation, explosion, civil disturbance, or hostile military or paramilitary action." [C.R.S. 1973 20-2-103] (Emphasis added]

Recommendations: It is the feeling of our group that several issues need to be given further study by the legal subcommittee.

1. State of Colorado - First, the whole federal pre-emption question should be defined. The A-95 directive may be an entry point for the state and local governments to participate in management decisions of Rocky Flats. That question should be resolved.

2. State of Colorado and/or Local Jurisdiction - The need to protect citizens from radiation hazards, demands an immediate study to determine the size of the protective ring around the Rocky Flats Plant. The zoning enabling legislation seems to permit the establishment of a special hazardous zone. The other alternative is to get the Atomic Energy Commission to aquire more ground around the 10,000 acres they now own.

3. Local Jurisdiction - Look into the Health Department's standards for exposure to radiation, to determine whether the county would prefer higher standards.

4. Local Jurisdiction - Use the Disaster Emergency Act to implement a county, local or interjurisdictional disaster plan, if one has not been implemented. If there is a local or county disaster plan, it should be scrutinized for possible modification. Not only must there be a disaster plan, but there must also be a clear chain of command and monitoring system. Each person and agency involved in the plan must know their role.

10 Feb., 1975

WIRTH-LAMM TASK FORCE ON ROCKY FLATS

SUMMARY OF PRELIMINARY FINDINGS OF MEDICAL COMMITTEE

(Drs. Robinson, Gillette and Cobb)

"With all the great powers man has recently acquired through his science and technology, it seems certain that he is now far too clever to be able to survive without wisdom." - E. F. Schumacher, The Age of Plenty

1. Plutonium's Long-term Health Effects.

Because plutonium is new in the world since 1941, knowledge of its long-term dangers to health is meager. In particular, little is known about the possible long-term health and possible genetic effects of inhalation of minute particles of plutonium oxide in amounts such as have been inhaled by many workers at Rocky Flats and residents of nearby areas of Colorado. (Refs. 1.1-1.6)

2. Present Plutonium Standards.

Reputable and knowledgeable scientists have argued convincingly that a real threat to health may exist under present standards for maximum permissible levels of plutonium in the air and in the lungs. These scientists recommend that standards should be stricter by several orders of magnitude than they are at present. (Refs. 2.1, 2.2) Other reputable and knowledgeable scientists (mostly associated with the AEC) assert that present standards are radiobiologically sound. (Refs. 2.3 and 2.4) The question is far from settled. (Ref. 2.5)

3. Epidemiological Studies.

Data to answer this question will have to come from many sources. Adequate epidemiological studies have not yet been done to see whether there have been significant increases of age-specific mortality, morbidity (heart and lung diseases), rate of aging, or problems associated with genetic reproduction among workers at Rocky Flats, among residents of nearby areas, or among animal populations living in contaminated areas near Rocky Flats. The data needed for such studies could

evidently be obtained. It would have to be a large and rather expensive study, and apparently funds have not been available. Such a study would help to answer the question about safety standards and would be well worth the cost. (Refs. 2.1-2.5 and 3.1 - 3.4)

4. Difficulties in Getting Autopsy Data.

While there have been about 300 autopsy cases from various places studied for plutonium (Ref. 4.1), there have only been about 30 autopsies done on former workers at Rocky Flats, many of them done in local hospitals. (Refs. 4.2 and 4.3) The autopsy reports and medical data have allegedly all been sent to the Transuranium Registry; and supposedly the pertinent information has been summarized in the annual report of the Transuranium Registry. Dow Chemical and ERDA representatives at Rocky Flats would make available to us neither these annual reports nor any autopsy reports done in local hospitals, saying they could be obtained only by permission from the Transuranium Registry.

In spite of the fact that the medical staff claim to have been trying for six years to get everyone at Rocky Flats to agree to release their medical data and give permission for an eventual autopsy for the benefit of the Transuranium Registry, they have signed up only about half of the present employees for medical data, and only about 5% of present employees for eventual autopsy. (Ref. 4.4)

The meager amount of human autopsy data available could to some extent be fortified by further careful studies of animals of various species. Various studies are now being carried out on animals from the Rocky Flats area and elsewhere. (Ref. 4.5) Some of the tissues of these animals have already been studied for plutonium concentration. The gonads are not being routinely included, which is unfortunate because of the important genetic implications.

5. Plutonium Concentration in Gonads

The recent EPA autopsy study of cattle from a range east of the Rocky Flats plant showed that heifer's ovaries contained much higher concentrations of plutonium and americium than did the other tissues studied. (Ref. 5.0)

A small number of measurements have been made of the concentrations of plutonium in human gonads. The possibility exists, and is supported by some of these measurements, that plutonium may be deposited in the gonads of humans where it could have serious effects on the germ cells and hence on the future generations of mankind. Studies currently being carried out on human autopsy material at the Los Alamos Scientific Laboratories which were presented to us in detail are to be commended in general. (Ref. 5.1) However, the method of analysis used, "the statistics of censored data", tends to obscure the relative concentration of plutonium in the gonads. The data are now being re-analysed with this in mind. (Ref. 5.2) More data from residents of the Rocky Flats area, exposed workers, and controls are needed. The epidemiologist of the Colorado Health Department could help in the study design and the Pathology Department of the Colorado General Hospital could help to get autopsy material with better occupational information and better data on places of residence and medical history. Under these conditions, such studies could contribute significantly toward answering the vital question of whether inhaled plutonium oxide dust from Rocky Flats may be causing harmful plutonium concentrations in the gonads of citizens living nearby. (Refs. 5.3-5.6)

6. Permanence of Plutonium Contamination.

The difficulties of decontaminating an environment polluted with small concentrations of plutonium are so great, and the decay rate of plutonium-239 is so slow (half-life over 24,000 years), that the only safe approach is to set interim standards now at most conservative levels, pending definitive studies to establish safety. If contamination of soil to a level of three orders of magnitude too high were inadvertently permitted through unwise premature setting

of safety standards, it would take a quarter of a million years for this plutonium to decay to a safe level. (Refs. 6.1 and 6.2)

7. Colorado Standard for Soil Contamination.

The level of plutonium contamination considered hazardous in uncontrolled areas is a maximum of 2 disintegrations per minute per gram of dry soil. This is based on incomplete knowledge and may be too lenient by a factor of ten, or more. (Ref. 7.1)

8. Problem of Plutonium-Contaminated Dust at Rocky Flats.

Wind-blown plutonium from the site of the cutting-oil spill at Rocky Flats has evidently contaminated an area to the east of the spill known as "the lip". Measurements of plutonium in this area ranging as high as 50,000 disintegrations per minute per gram of dry soil were reported to us by Prof. Lesley Fraley of CSU. (Ref. 8.1) It is possible that plutonium from this area may now be subject to resuspension by gusts or "dust devils" and may be blown into nearby residential areas in hazardous amounts. This cannot be ruled out by data from the present monitoring system. (Ref. 8.2) We were not satisfied that adequate study of the factors involved in resuspension of the plutonium in this area has yet been made in order to assess the risk to residents. Prof. Fraley believes there would be some danger of stirring up and further spreading of plutonium from the proposed mechanical removal of this contaminated soil. An environmental impact statement has not been filed on this proposed removal by ERDA. (Ref. 8.3)

9. Danger from Plutonium Fires at Rocky Flats.

Plutonium, under some conditions, will burn spontaneously forming plutonium oxide dust of extremely small particle size. (Refs. 9.1 9.2) These extremely small particles are most dangerous because they are hard to filter and when inhaled are likely to be deposited in the alveoli of the lungs where they slowly

destroy the lung tissue. One milligram of this dust (one thirty-thousandth of an ounce) would be about 280 million particles, would produce about 140 million alpha disintegrations per minute, and would be a lethal dose. (Ref. 9.3) Theoretically, a very few such particles, weighing a million millionth of a gram each, inhaled into the deep lung tissue could initiate a cancer. (Refs. 1.2 and 1.3)

The numerous plutonium fires at Rocky Flats have resulted in excessive exposures of workers; and unknown amounts of plutonium oxide dust have been released to the atmosphere. The 1969 fire seriously breached the containment systems in the building and nearly caused a major release to the atmosphere. Significant and expensive improvements have now been made which should be adequate to protect personnel and the community, assuming the present plutonium standards for air and lung burden are adequate. If present standards are too lenient by several orders of magnitude (see item #2), then even the present containment systems might prove to be inadequate. Data could be obtained to evaluate these containment systems with regard to standards stricter by several orders of magnitude.

10. Danger of Atomic Fission Reactions at Rocky Flats.

Criticality incidents (chain reactions releasing intense radiation and atomic fission products) present an especially serious hazard. Criticality research is done at Rocky Flats in a building which, we were told, can prevent escape of radiation or fission products. Criticality accidents may also occur in other areas. If so, special alarms would be sounded so that personnel in that building would be warned to escape by the nearest exit. A large criticality accident, such as might result from sabotage or even from an airplane crash into a plutonium storage area, could present a most serious health hazard to the people of metropolitan Denver. It could produce a wind-borne cloud of radioactive substances, including Iodine-131, which, when inhaled,

is rapidly taken up by the thyroid gland and may cause serious hormonal deficiency or cancer. Partial protection may be provided by administration of a potassium iodide tablet to everyone by mouth before the cloud of iodine-131 reaches them. (Ref. 10.1) If the wind were blowing toward Denver at 8 miles per hour (prevailing conditions), there would be insufficient time (less than 2 hours) in which to get these tablets to most citizens. Cows in the area also would absorb iodine-131 and strontium-90 which would get into the milk and endanger those who drink it. This would require testing and disposal of contaminated milk.

11. Danger from Transportation Accidents.

One of the most serious potential health hazards connected with Rocky Flats is the danger to Colorado citizens from accidents involving transportation of plutonium and other radioactive nuclides. Sabotage or an accident involving an explosion or a fire could result in the dispersal of plutonium etc. into the environment. Such accidents occurred when unarmed atomic bombs fell and were blown apart on Palomares in Spain and Thule in Greenland. These accidents required extensive clean-up effort. (Ref. 11.1) We were not satisfied that adequate safeguards are maintained to prevent transportation accidents. In fact it may not be possible to provide adequate protection for such shipments without seriously impinging on the civil liberties of citizens of Colorado. (Ref. 11.2) (Criticality accidents in transportation are unlikely because presumably critical masses of plutonium, etc. are not put together in one shipment, but we did not investigate this.) If a transportation accident should occur outside of Denver, it might be some time before the nature of the radioactive substances could be determined. This would delay appropriate protective measures or evacuation procedures. Rural communities might be incapable of handling such an emergency.

12. Medical Staff at Rocky Flats.

The plant currently employs only one physician and eight registered nurses, who staff the clinic around the clock. The physician is a former Army Colonel who has had some experience in nuclear medicine. None of the medical staff have received a degree or certification in the fields of industrial medicine or public health, both of which are generally considered desireable for medical staff in an industry of this degree of industrial health risk. (Ref. 12.1) There is currently a vacancy for the position of the head of the medical staff, but the job requirements even for this position at the present time do not include formal training in industrial medicine, Medical Supervision of radiation workers, or public health. Dr. Miller is on 24-hour call every day, and there is no established arrangement for getting a substitute doctor experienced in nuclear medicine in case Dr. Miller were unavailable in an emergency. A physician not experienced in nuclear medicine could not be expected to know how to handle a wound contaminated with plutonium. Under present circumstances, until arrangements are made with a community hospital, such a wound would have to be handled in the clinic at Rocky Flats, because special monitoring equipment is needed during the surgery, and special equipment and drainage collection is needed for proper decontamination. It is anticipated that Rockwell International might want to improve the medical staff and facilities.

13. Surgical Facilities at Rocky Flats.

Until a working arrangement is implemented with a community hospital like CGH, surgery on seriously contaminated individuals would have to be done at Rocky Flats. The surgery there is equipped only for minor surgical procedures under local anesthesia. Serious injuries, including complicated injuries to the hand, may require general anesthesia. Proper gas anesthesia equipment is not available at Rocky Flats. Thus personnel with such serious injuries could not now get optimal treatment.

14. Emergency Medical Treatment Plans.

We have not yet been shown any adequate document describing the various procedures to be used in various types of anticipated industrial accidents involving radionuclides at Rocky Flats. (Refs. 14.1 and 14.2) As a result of our inquiry, emergency plans of various kinds are now being developed by ERDA and Dow Chemical staff; We understand that they are looking into various maximum credible accidents in order to facilitate development of appropriate community arrangements to help the medical staff at Rocky Flats in case of an accident which involved a large number of victims with contaminated wounds and/or radiation exposure, etc. A plan for the care of radiation accident victims at the University of Colorado Medical Center which was initiated several years ago has, only since our inquiry, been discussed with the Medical Center with the purpose of implementation. (Ref. 14.3) We were not informed of similar arrangements with any other community hospitals.

15. Questions about Monitoring.

Employees at Rocky Flats are concerned that monitoring may not be adequately done by the staff employed by Dow Chemical Company. Clearly the monitoring staff are drawn between their desire to do the best for the workmen on the one hand, and protecting the interests of the company on the other. The Union understandably would like to have an independent check on the monitoring process and an available appeal to an outside agency in case they suspect that a dangerous situation is not being properly handled, or in case they think workers may be receiving an excessive exposure. Some duplication of monitoring by an outside agency, such as the State Health Department, would clearly help to allay fears of the workers and insure that proper precautions are taken. The additional cost is justifiable. (Ref. 15.1)

16. Limit of Sensitivity of Whole Body Counting.

The three whole body counters at Rocky Flats are probably more sophisticated than any in the State, but according to Mr. Lagerquist, they cannot detect a lung burden of plutonium unless the plutonium contains at least 200 parts per million of americium which produces a gamma ray strong enough to be detectible through the chest wall. Thus individuals who were exposed to inhalation of plutonium oxide dust from a fire occurring in the nearly pure plutonium (such as is used in weapons) could have received a lung burden in excess of the maximum permissible level of 16 nanocuries and this could only be determined by the body-counter equipment at Rocky Flats after americium had grown in over a period of a year or more. The question of whether or not the best available equipment is being used in the most effective manner could be settled by having outside independent experts review the equipment and the procedures on a yearly basis, with the report going to a citizens committee, to the Union, and to the State Health Department. This would help further to allay the concerns of the workers.

17. Questionable Need to Use Such Pure Plutonium.

If the weapons could be constructed using plutonium which contained about 500 parts per million of americium, the immediate detection of maximum permissible lung burdens would be possible and the health of the workers would be better protected as regards inhaled plutonium. This would mean, however, that the workers who machine the plutonium would need better protection from the gamma rays of americium. This might require a different procedure which might slow up the process and be more costly. It would, however, be consistent with the general policy of keeping radiation exposures as low as practicable. (Ref. 17.1) The advantage in using pure plutonium for the bomb triggers, has to be balanced against the potential hazard of not being able to evaluate lung burdens for a year or more after exposure.

18. Reluctance of Dow to Release Body-Counter Data.

Because the Union is concerned about the degree of exposure to inhaled plutonium of the workers, they would like to have all health physics data (including body-counter measurements, film-badge measurements, etc.) made available for scrutiny by an outside independent group of experts who would report to the Union and to the State Health Department regarding the number of individuals in each of various exposure level categories and the adequacy of protective measures. This would not breach the privacy of medical records and it would provide the Union with data they need in order to press for better environmental controls. Of course, the data for any indivual should routinely be made available to himself and to his own private physician. Furthermore, by signing appropriate releases, any individual should be able to have the data made available to his lawyer, to the Union, to his insurance company or to the State Employment Compensation Agency. Such releases of these data are not currently encouraged by the Dow Chemical Company and the ERDA, with the result that workers are left in ignorance of the degree of exposure they have received and the adequacy of protective measures in general.

19. Chromosome Studies.

We reviewed the procedures and the data gathered so far in the study of chromosome abnormalities in the peripheral lumphocytes of workers exposed to different degrees of radiation and in a few controls. We had some questions about the procedures and methods used in assigning individuals to the various groups. The data have not yet been analyzed statistically, but it appears that there may be some relationship between exposure to plutonium on the job and the prevalence of chromosome breaks and rearrangements seen. A more carefully designed study using modern techniques and involving many more individuals and with better data on exposure, would be helpful in deciding whether chromosome studies would be useful as a measure of radiation exposure under the conditions

of work in this plant. Such a study would be quite expensive, but the information to be gained toward improving methods of radiation exposure control would be worth the cost.

NOTES AND REFERENCES

1. Plutonium's Long-term Health Effects

1.1 Burr, W. W., Jr. (Dec. 1974) US AEC, WASH 1359 p. 231, "Biomedical Effects of Plutonium in Humans." He points out that little information is available on humans.

1.2 Martell, E. M. (Jan. 1975) Statement at EPA hearings, Denver, "Basic Considerations in the Assessment of the Cancer Risks and Standards for Internal Alpha Emitters"

1.3 Tamplin, A. R. and Cochran, T. B. (Feb. 1974) Natural Resources Defense Council, "A Report on the inadequacy of existing radiation protection standards related to internal exposure of man to insoluble particles of plutonium and other alpha-emitting hot particles."

1.4 Voelz, G. L. (Jan. 1975) Health Division Leader, Los Alamos Scientific Laboratory; Letter to Dr. Cobb stating that he is not aware that any studies have been reported on genetic effects due to plutonium.

1.5 I.C.R.P. Publication #18 (May 1972) Pergammon Press "The RBE for High-LET Radiations with respect to Mutagenesis". See p. 37, "Conclusions...there are still several important gaps. In particular, it would be useful to have genetic information from animals irradiated with a wider range of LET's, and from mammals with oocytes more comparable to the human one than is the mouse oocyte...."

1.6 Stannard, J. N. (1973) in Handbook of Experimental Pharmacology Series, "Uranium, Plutonium, Transplutonics", Edited by Hodge, H. C., Stannard, J. N., and Hursh, J. B. (Berlin) "While hardly to be expected from plutonium, we cannot eliminate genetic changes as a possible long-term result of contamination of the biosphere with other radionuclides. Experimental work in this area is almost non-existent, in contrast to extensive studies with external radiation."

2. Present Plutonium Standards

2.1 See references 1.2 and 1.3 above. The concerns expressed by these scientists (Martell, Tamplin and Cochran) have been discussed widely (See refs. below) but have not been disproved. Clearly further laboratory and epidemiological studies will be needed to settle the question.

2.2 See, for example, Dr. Martell's proposal to the U.S., E.P.A. dated Oct. 1974, "Evaluation of the Cancer Risks from Insoluble Particles of Low Specific Alpha Activity in Man."

2.3 Bair, W. J., Richmond, C. R. and Wachholz, B. W., U.S., A.E.C. publication (Sept. 1974) WASH 1320 "A Radiobiological Assessment of the Spatial Distribution of Radiation Dose from Inhaled Plutonium."

2.4 Healy, J. W., Richmond, C. R., and Anderson, E. C. (Nov. 1974) U.S., A.E.C. Los Alamos Informal Report LA-5810-MS "A Review of the Natural Resources Defense Council Petition Concerning Limits for Insoluble Alpha Emitters."

2.5 Hendee, W. (Jan. 1975) Personal Communication included in written Testimony of Dr. Cobb at the U.S., E.P.A. hearings on Plutonium Standards in Denver on January 10th, 1975.

3. Epidemiological Studies

3.1 Burr, W. W. (ref. 1.1 above) p. 233-4, "Follow-up studies attempting to establish whether any detectable increase in relevant disease may be seen in the exposed populations will become increasingly important."

3.2 Martell (ref. 2.2 above, pp. 15-23, and ref. 1.2 above p. 19) describes several types of studies needed to settle the questions regarding the effects of inhaled insoluble particles of low specific alpha activity in man.

3.3 Lloyd, J. W. (Feb. 1971) J. Occup. Med. 13, p. 53 "Long-term Mortality Study of Steelworkers, V. Respiratory Cancer in Coke Plant Workers."

3.4 Redmond, C. K., Ciocco, A., Lloyd, J. W. and Rush, H. W. (Aug. 1972) J. Occup. Med. 14 p. 621, "VI - Mortality from Malignant Neoplasms among Coke Oven Workers," The above two studies are good examples of the kinds of epidemiological investigations which should have been started long ago among plutonium workers. Actually there is some basis for suspecting that the cause of the lung cancers in coke plant workers may be from inhaled insoluble alpha-emitting particles coming from the coke oven fumes.

4. Difficulties in Getting Autopsy Data

4.1 Campbell, E. E. et al., (Jan. 1973) U.S., A.E.C. publication LA-4875 "Plutonium in Autopsy Tissue". The autopsy material for these studies came from various sources. Unfortunately the important epidemiological information such as place of residence and occupation were not obtained for the autopsies from Colorado. Thus this report sheds little light on the question of whether working at or living near Rocky Flats contributes to body burden of plutonium.

4.2 Lagerquist, S. E. et. al. (Dec. 1973) Health Physics, p. 581, "Distribution of plutonium and americium in occupationally exposed humans as found from autopsy samples." Unfortunately, none of these had measurements of gonad tissue.

4.3 Lagerquist, S. E. et. al. (Jan. 1975) Discussion at Rocky Flats. Gonad tissue is now being measured, but the data was not available at Rocky Flats.

4.4 Bean, McElvey, Lagerquist, Miller, et al. Information provided at Rocky Flats visit: Number agreeing to release medical data = 1489; Number giving permission for autopsy - 156.

4.5 Whicker, W. et al. (1974) 12th Technical Progress Report to U.S., A.E.C. "Radioecology of Some Natural Organisms and Systems in Colorado". Colorado State University.

5. Plutonium Concentration in Gonads

5.0 Smith, D. D. and Black, S. C. (Jan. 1975) U. S., EPA Publication NERC-LV-539-36, Actinide Concentrations in Tissues from Cattle Grazing Near the Rocky Flats Plant

5.1 Campbell, E. E. et. al. (Jan. 1973) See 4.1 above. In the few cases in which gonads and other tissues were measured, and where the disintegration counts were high enough, so that the measurements were considered reliable, the specific plutonium alpha activity (Per kg of tissue) was generally signficantly higher in the gonads than in other tissues such as the liver or lungs.

5.2 Cobb, J. C. (Jan. 1975) Letter to James F. McInroy of LASL regarding the deficiencies of the statistical methods used in his analysis of human gonadal plutonium concentrations.

5.3 Richmond, C. R. and Thomas, R. L. (Aug. 1974) U.S., A.E.C. preprint LA-UR-74-1314 (Revised) "Plutonium and other actinide elements in gonadal tissue of man and animals." A good review of the literature, but in this paper, the analysis of human gonadal plutonium concentrations, as compared with that of other tissues, suffers from the statistical errors mentioned under 5.2 above. Furthermore, the data on animal gonads (Tables 1-5) are all for relatively short periods of time, less than 2 years; and most of the data pertained to soluble forms of plutonium.

However, when insoluble plutonium oxide in very small particle size is inhaled, it probably takes a few years for the particles to get carried from the lungs (See 5.4 below) to the gonads, where they perhaps tend to remain rather permanently. (See ref. 5.5 below) Thus we might expect the proportion of body plutonium in the gonads to increase with time over a long period of years. This could be studied if we had adequate pertinent epidemiological data on each autopsy case.

5.4 IAEA, Vienna (1973) Technical Reports Series No. 142 "Inhaled Risks from Radioactive Contaminants" (See pp. 72-74).

5.5 Bair, W. J., (Dec. 1974) U. S., A.E.C. publication, WASH-1359 "Plutonium and Other Transuranic Elements". See discussion of factors effecting retention of plutonium oxide particles in the lungs and its translocation to other tissues, pp. 174-183. See also discussion by Volchok, H. L. in the same volume (WASH-1359) p. 155-168 and the table on p. 168, summarizing studies of plutonium in aquatic animals. For fish, these studies showed that the concentration of plutonium in the bone ranged from 30 to 600 times that of the concentration in the water. Bivalves off the Danish coast were found to have concentrated the plutonium by factors as high as 8,200 times the concentration in the water.

5.6 ICRP Publication #19 (May 1972) Pergammon Press "The Metabolism of Compounds of Plutonium and other Actinides." See discussion of retention of deposited actinides in various tissues, pp. 38-48. In particular, on P. 44, describing the unpublished research of Rosenthal, M. W. and Lindenbaum, A., work on the lifetime retention of intravenously injected plutonium in mice, the authors state, "For the first year, or less, after monomeric Pu (0.07 to 1.0 μCi/kg) there was some net loss of radioactivity from most tissues (kidneys, gastrointestinal tract, muscle, lungs, lymph, adrenals, etc.) but no loss from spleen, ovaries, or uterus.... Similarly, there was no significant loss of curium from the rat testis over a period of 490 days after intravenous injection of curium citrate; or of actinium over a period of 189 days after intravenous injection of actinum serum protein complex; or of plutonium from rat ovary for 146 days after injection of plutonium nitrate (Taylor, unpublished)."

6. Permanence of Plutonium Contamination

6.1 Langham, W. H. (Dec. 1968) U.S. Dept. HEW, Environmental Control Administration, Seminar paper No. 002, "The Problem of Large-Area Plutonium Contamination". This paper describes graphically the problems of decontamination after the accidental dispersal of plutonium from unarmed nuclear weapons which crashed near Palomares, Spain on Jan. 16, 1966; and near Thule, Greenland on 21 Jan, 1968. It also gives a most enlightening and frightening discussion of the general problem of plutonium contamination.

6.2 Poet, S. E. and Martell, E. A. (Oct. 1972) Health Physics 23, p. 537, Plutonium-239 and Americium-241 Contamination in the Denver Area." This paper reports the work which first alerted citizens to the dangers from the Rocky Flats plant.

7. Interim Standard for Soil Contamination

7.1 Hazle, A., Colorado State Health Dept. Testimony at E.P.A. hearings on Plutonium Standards, Denver, Jan. 10, 1975. This paper gives an excellent discussion of the considerations and compromises involved in arriving at this interim standard. "The actual wording of the Colorado Standard is as follows: 'Permissible levels of radioactivity in uncontrolled areas. Plutonium. Contamination of the soil in excess of 2 disintegrations per minute of plutonium per gram of dry soil or square centimeter of surface area (0.01 micro-curies of plutonium per square meter) presents a sufficient hazard to thepublic health to require the utilization of special techniques of construction upon the property so contaminated. Evaluation of proposed control techniques shall be available from the Department of Health upon request.'" Based on their studies, the Health Department had recommended to the State Board of Health a standard of 0.2 dpm/g. The 2 dpm/g standard represents a compromise.

8. Problem of Heavily Contaminated Dust at Rocky Flats

8.1 Fraley, L. Written testimony presented to the Rocky Flats Task Force on Jan. 21, 1975.

8.2 Cobb, J. C., Memo to Mr. Sick, Chairman of Task Force data 14 Jan 1975 (copy attached). This memo discusses the wind tunnel studies done for Dow Chemical and the inadequacy of the monitoring system to surely detect plumes of plutonium-contaminated dust blowing from the "lip area".

8.3 Bean, Earl, U.S. ERDA, Rocky Flats, Oral Statement to the Task Force on Jan. 21, 1975 to the effect that an environmental impact statement was deemed unnecessary by the AEC, but agreeing that this might be disputed.

9. Danger from Plutonium Fires at Rocky Flats

9.1 Schwendiman, L. C., Mishima, J., and Radasch, C. A. (Aug. 1968) U.S., A.E.C. paper for oral presentation at symposium on airborne radioactive wastes, United Nations, New York, "Airborne Release of Particles in Overheating Incidents involving Plutonium Metal Compounds". The MMD of airborn particles was found to be 4.2 microns.

9.2 Mishima, J. and Schwendiman, L. C. (Oct. 1970) U.S., A.E.C. paper presented at symposium of Health Physics Society, Idaho Falls, Nov. 3-6, 1970. "The Amount and Characteristics of Plutonium made Airborne under Thermal Stress." When plutonium was ignited, 70% to 80% of the airborne plutonium oxide was in particles of under 0.5 microns diameter.

9.3 Bair, W. J. (Dec. 1974) in AEC Report WASH-1359 "The Biological Effects of Transuranium Elements in Experimental Animals." See Figure 24, p. 229.

10. Danger of Atomic Fission Reactions at Rocky Flats

10.1 Howells, H. (1969) in Environmental Contamination by Radioactive Materials I.A.E.A, Vienna STI/PUB/226 "The plan and organization to deal with large-scale accidents causing environmental contamination".

He describes plans involving Iodine-131 release, and related problems, including need for monitoring and reporting for decision-making in time to evacuate populations, provide Iodide tablets, etc.

11. Danger from Transportation Accidents

11.1 Langham, W. H. (Dec. 1968) (See ref. 6.1 above)

11.2 Nader, R. (Jan. 28, 1975) Straight Creek J., p. 5, "Va. Power Company Wants Private Nuke Police"

12. Medical Staff at Rocky Flats

12.1 IAEA Safety-Series No. 25, (1968) WHO-ILO publication Medical Supervision of Radiation Workers. See pp. 100-117 for description of desireable aspects of medical supervision, for example: "Finally, an additional reason for medical surveillance is to demonstrate over a long period the normality

of the incidence of disease in groups of people exposed to radiation within the permissible limits." - The only such effort that we heard about at Rocky Flats was a study of cancer incidence, which we asked for but has not yet been made available to us.

14. Emergency Medical Treatment Plans

The documents we saw were as follows:

14.1 Rocky Flats Plan (June 1970) State of Colorado Department of Military Affairs, Civil Defense Division

14.2 "Emergency Program at Rocky Flats Plant" (Jan. 1975) a brief unsigned, undated, unofficial summary provided to us by the ERDA.

14.3 "Plan for the care of radiation accident victims at the University of Colorado Medical Center" an undated, unofficial proposal of several years ago, on which no action had been taken until our inquiry.

15. Monitoring: From Mr. Al Hazle, we obtained an estimate for the cost of up-grading the present whole-body counter at the State Health Department, so that it could make measurements of plutonium lung burdens, etc. as well as the equipment at Rocky Flats, or better. The cost would be approximately $35,000 for equipment and about $25,000 yearly for personnel and supplies. If the work-load were more than a few determinations per day, a small computer would be needed to speed up the computations. The whole-body counter at CSU could also be upgraded in the same way for about the same cost.

17. Questionable Need to use Such Pure Plutonium.

17.1 ICRP Publication 22, (Apr. 1973) "Implications of Commission Recommendations that Doses be kept as Low as Readily Achievable." Pergammon Press.

ROCKY FLATS TASK FORCE

Occupational Sub-Group

Pat Kelly, Chairman
George Lucus
Wesley Brittin

Feb. 10, 1975

Since man made the first microgram of Plutonium, there has been a continual learning process regarding the properties and use of the material and the unique dangers associated with this man-made element.

Those that first worked with plutonium, though somewhat awed by it's properties and possibilities, did not accord it all the respect it was and is due. Accidents and incidents took their toll in the cases of Dr. Slotin and Dr. Kelley and took a further toll in the case of the Marshallese Islanders.

Since that time, scientists have recognized the inherent dangers associated with the production and use of plutonium. Indeed, it has often been described as "the most toxic substance known to man".

Because of the unique properties and dangers associated with plutonium, elaborate, complicated and expensive facilities had to be constructed to enable man to work with this material safely. The facilities that were constructed were primarily government facilities operated by civilian or other governmental contractors. Rocky Flats is such a facility, it is government-owned and has been operated by the Dow Chemical Co. since it was first built. Since the work done at Rocky Flats was defense oriented and since most all nuclear materials work was secret, the public knew very little about what really was produced at Rocky Flats. The cloak of secrecy was ever present in the minds of the workers, they were constantly reminded not to disclose anything about the plant or product.

The cloak of secrecy also protected the A. E. C. and Dow from public perusal and therefore also from criticism.

As time passed and other nations achieved nuclear capability, some of the secrecy cloak was pulled aside and the public was told of some of the things that went on at Rocky Flats.

The public discovered that some things that went on were not desirable, and in fact they might be dangerous. Over a period of years the public learned that barrels (drums) of contaminated oils and solutions had been stored in a field in the south-east portion of the plant. They also learned that other drums containing contaminated waste had been buried in mounds in another area of the plant. The drums containing the oils and solutions deteriorated and allowed the contents to spill upon the ground. The soils thus contaminated were picked up by strong winds and the plutonium was dispersed over a fairly large area east of the plant. The drums containing contaminated solid waste were unearthed and processed through the waste-treatment facility of the plant. Most all of the plutonium that contaminates the soil east of the plant came from the drums of contaminated oil. The mistake of allowing those conditions that contaminated the soils was a management error. The error was man-made, therefore any solution to the problem must also come from man. As an interim solution, it was decided to cover the contaminated field with a thick layer of asphalt, thereby temporarily containing the contaminated soil to prevent further dispersion of plutonium. An uncovered area, commonly called the lip, is scheduled to be removed in the near future. It is believed that these measures will prevent any further contamination due to this source of soil east of the plant.

The public has also learned that there are other problems at Rocky Flats. However, those problems concern the people working at the plant.

The workers are exposed to levels of radiation and contamination many times those allowed the general public. The very nature of the work demands this. There should not be unnecessary risks taken just for the sake of production, the workers should not needlessly be exposed to radiation or be subjected to internal or external contamination through erroneous management decisions or practices. The worker should be afforded all the protection it is practically possible to supply.

According to an A.E.C. report:[1]

> 'The distributions and interactions of the absorbed energy from alpha-emitting plutonium particles among the cellular elements in lung tissue are difficult to examine experimentally and,

therefore, have to be considered on a theoretical basis. This requires integrating our knowledge of the properties of alpha radiation with our understanding of the dynamic characteristics of lung, the cell types which populate lung tissue and the interactions which occur between cellular constituents and plutonium particles."

A report to the United Nations[2] summarizes some of the ways in which individuals may be exposed to occupational radiation.

"Individuals may be exposed to radiation as a consequence of their occupation, either because they are directly engaged in radiation work (medical practices, industry, research etc.) or because their occupational activities take place where exposure to radio-activity is significant. The exposures can be external or internal, the latter arising through inhalation of radio-active gases and dusts, and through ingestion of radio-active material.

Some data are now available from five industrialized countries on the number of subjects occupationally exposed. These range from 0.3 to 0.8 individuals per thousand of total population, and figures from countries with comparable medical and industrial standards are probably not higher.

Data have also become available on the occupational genetically significant doses in three of the countries referred to above. These do not exceed 0.5 mrem per year as averaged over the whole population. In one of these countries about 40 per cent is due to irradiation incurred in atomic plants."

If one assumes that the NRC standards and limits are valid and are not too high, then the work force at Rocky Flats must be placed in three groups. The first group being those that have not worked with plutonium or other sources of ionizing radiation. This group should, conceivably have no more of a dose rate or level than does the general Colorado populace. The second group that must be considered consists of those who are, or have been, occupationally exposed to plutonium, americium or other radioactive sources or materials, but who, according to present dosimetry reports, have not received an amount

of exposure at or above the permitted dosage limits. The third group to be considered are those who have received an occupational dose at or above the permitted "safe" limits.

At the present time it is impossible to determine how many people fall into each of the above categories. The fact that neutron dosage was not even considered for several years is significant. The fact that detection of dose rate in the early years was very crude compared to today's methods is also significant. Even with today's improved methods with a much greater sensitivity the question of accuracy in dose rate determinations is still questionable. For example, the determination of Pu in the lungs depends upon an assumed Pu/Am ratio.

At various times it has been reported that some 170 people have been exposed to "significant" dose rates during the course of their employment at the Rocky Flats plant. These rates have been reported as ranging from above 5 rems/yr to approximately 150 rems or 17 "body burdens". The determination of these exposures has been in the hands of one group, Dow Chemical Co. There have been no independent surveys of dosimetry programs to determine if reported dosimetry results are accurate. There have been no independent dosimetry surveys or programs to determine if the methods of determining dose rates are correct, updated and, scientifically, the most advanced.

There have been no follow up programs to determine cause of death, age at death, etc. except for the voluntary program of the Transuranium Registry.

At this time, it is impossible to determine if occupationally exposed workers suffer from a higher cancer incidence than the general public. It is impossible to determine if the life span of the occupationally exposed worker has been shortened. In essence little or no information is available on those occupationally exposed workers who have left the employ of the Dow Chemical Co. operated Rocky Flats plant. There have been no independent surveys made to determine whether or not the best and most safe practices are in use at the Rocky Flats plant - those determinations were left to Dow management and the A.E.C. (now ERDA).

As stated previously, neutron exposure was not given proper consideration and neutron dosimetry was not even measured or reported until after 1964. It is not known whether workers were exposed to neutrons at Rocky Flats prior to 1964. It has only been recently that chromosome studies have been made on occupationally exposed workers at Rocky Flats and again this program is a voluntary one.

It is generally accepted that in all probability (assuming no massive exposure has occurred) that it may take many years, sometimes 20 or more, before clinically evident damage appears to an exposed individual. The Colorado Occupational Disease Act takes this into account and therefore in Section 81-18-11 of the Act under the Title "Limitations upon time for filing claim" states:[3]

> "(1) Except in cases of disability or death resulting from exposure to radioactive materials, substances, or machines, or fissionable materials or any type of malignancy caused thereby, or poisoning by uranium or its compounds, the right to compensation and benefits as provided in this chapter shall be barred unless, within one year after the commencement of disability or date of death, a notice claiming compensation shall be filed with the division of labor; except that this limitation shall not apply when it is established to the satisfaction of the director of the division of labor within two years after the commencement of disability or date of death that a reasonable cause exists for the failure to file such notice claiming compensation, and the employer's rights have not been prejudiced thereby.
>
> (2) In cases of disability or death resulting from exposure to radioactive materials, substances, or machines, or fissionable materials of any type of malignancy caused thereby, or poisoning by uranium or its compounds, the right to compensation and benefits shall be barred unless within three years after the commencement of disability or death a notice claiming compensation shall be filed with the division." (emphasis supplied)

"(3) These limitations shall not apply to any employee to whom compensation has been paid and the furnishing of medical, surgical, or hospital treatment by the employer shall not be considered payment of compensation or benefits within the meaning of this section."

The act also states in Section 81-18-10[4] (1) (b) in part: "The burden of proof shall be upon the employee to establish each and every such fact by competent medical evidence".

Since it is and has been recognized that clinically evident disability due to radiation exposure may not surface for 20 or more years, it would appear that in effect, the Colorado Occupational Disease Disability Act as presently written affords little protection to workers such as those employed at Rocky Flats.

An example of the futility of the application of the Colorado Act might be the exposures that 25 Rocky Flats employees received on Oct. 15, 1965 as reported by Mann and Kirchner.[5]

"It may be instructive to look at a specific instance of an industrial accident which was reported by Mann and Kirchner (1967). On October 1965, a fire in a plutonium fabrication plant resulted in a large-scale spread of plutonium oxide. The Rocky Flats body counter was used to measure the plutonium in the lungs of all employees working in the area and, of approximately the 400 employees counted, 25 were found to have enough plutonium in their lungs to deliver a dose of 15 rem per year or greater (i e., at least 0.016 μCi). Data from each employee were obtained with a pair of scintillation detectors in contact with the subject's chest; the 60 keV photon peak of ^{241}Am was used in the measurements. The ^{241}Am content of the plutonium released in the fire was determined, and the plutonium quantity was then estamated from calibrations using a chest phantom with similar $^{241}Am/^{239}Pu$ ratios. The plutonium consisted of "high-fired" PuO_2; particle size measurements of air samples collected after the fire indicated a 0.32 μm mass median diameter (MMD) with a geometric deviation (σ_g) of 1.83. Lung counting data to date show a slow clearance of plutonium, confirming the high degree of insolubility of the inhaled material. On the average, 30% of material initially

deposited in the lung was cleared in 2 to 3 months, with the remaining material clearing slowly with little or no measurable absorption into the bloodstream.

Of the 25 people who were involved in the Rocky Flats incident, two had burdens as high as 0.16 μCi, a factor of 10 above the current maximum permissible lung burden. Of those available for follow-up, most are measured for retained activity several times each year. Information from these cases should ultimately be included in the U.S. Transuranium Resigtry (USTR)."

There is no independent determination as to proper staffing of personnel in those classifications that are essential to protect the health and safety of the workers at the Rocky Flats plant.

Because of the nature and properties of the materials processed, the Rocky Flats plant potentially is a dangerous and hazardous operation. Therefore, in order to protect the general populace and the workers, it is mandatory that proper and effective operational safeguards and proper and effective health and safety procedures be enforced.

At the present time there is no independent group that could insure that such practices are followed.

References

1. W. J. Bair, C. R. Richmond and B. W. Wachholz, "A Radiobiological Assessment of the Spatial Distribution of Radiation Dose from Inhaled Plutonium", United States Atomic Energy Commission, September 1974 Wash-1320, p. 31.

2. "Report of the United Nations Scientific Committee on the Effects of Atomic Radiation", General Assembly, Official Records: Seventeenth Session, Supplement No. 16 (A/5216), United Nations, p. 23.

3. "The Colorado Workmen's Compensation Act; Occupational Disease Disability Act, Medical Disaster Insurance Fund Act and Colorado Major Medical Insurance Fund Act", Division of Labor, Denver, Colorado 1974, p. 87.

4. Ibid., p. 85.

5. W. J. Bair et al., op. cit. p. 27.